REDWOOD MEADOWS

a new community in the foothills
by Sarcee Development Ltd.

SARCEE DEVELOPMENTS LTD.

3700 Anderson Rd. S.W.
P.O. Box 66
Calgary, Alberta T2W 3C4

June 15, 1981

RECEIVED

JUN 15 1981
In the office of
THE MINISTER of
The Department of
MUNICIPAL AFFAIRS

Hon. M. E. Moore,
Minister of Municipal Affairs,
423 Legislature Bldg.,
Edmonton, Alberta.

Dear Sir:

RE: Redwood Meadows Master Plan by,
Sarcee Developments Ltd.

It is with a great amount of pride that we present to you a copy of our Master Plan for our Redwood Meadows residential subdivision west of Calgary. Our representatives making this actual presentation are prepared to bring you up to a current awareness of our progress; as well as presenting you with a separate document that generally outlines some of the history, planning, utilities and delivery of services behind Redwood Meadows. Please ask questions of our representatives to your satisfaction of having a comfortable understanding of our project.

It is our understanding that much progress has been made, regarding settling the Jurisdiction matter for Redwood Meadows since taken under the co-ordination of Hon. D. McCrimmon in April, 1980. It is further our understanding that a formula is near completion as to how Redwood Meadows can operate as a normal municipality under Province Jurisdiction. We are told that the expedient development of this formula progressed as a result of a great deal of co-operation and assistance from Alberta Government representatives. This is greatly appreciated.

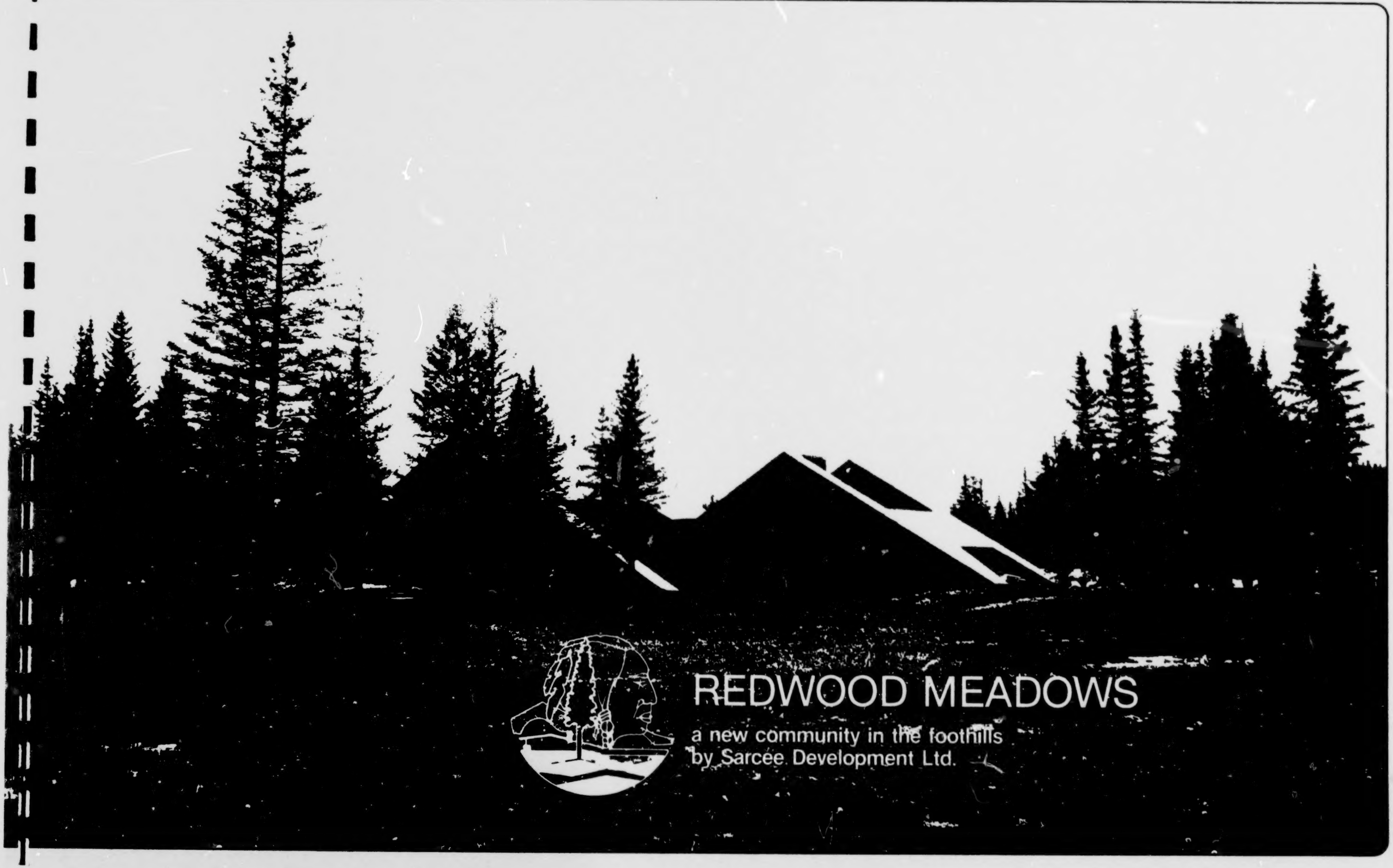
Hopefully this Master Plan and the background document will serve in preparing you for consideration of this proposed "Formula to Provincial Jurisdiction at Redwood Meadows" which will be ready for presentation to all authorities in the near future.

Yours respectfully,

Loyal Whitney

Chief Clifford BigPlume,
Sarcee Indian Band.

Mr. Loyal Whitney, President
Sarcee Developments Ltd.



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1 INTRODUCTION

1.0 INTRODUCTION

1.1 LOCATION

Redwood Meadows is located about 25 km west of Calgary along the western boundary of the Sarcee Reserve. The site is bounded on the east by Highway 22 and on the west by the Elbow River, as shown on Exhibits 1.1 and 1.2.

EXHIBIT 1.1

REGIONAL LOCATION

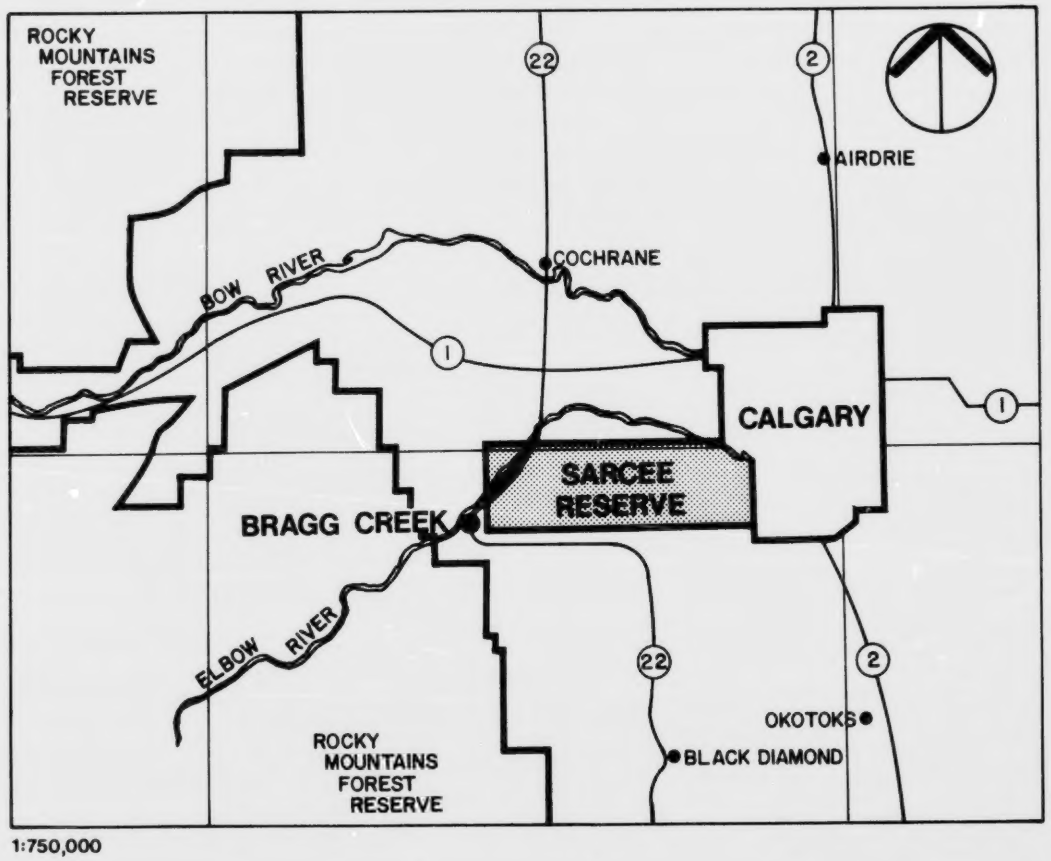
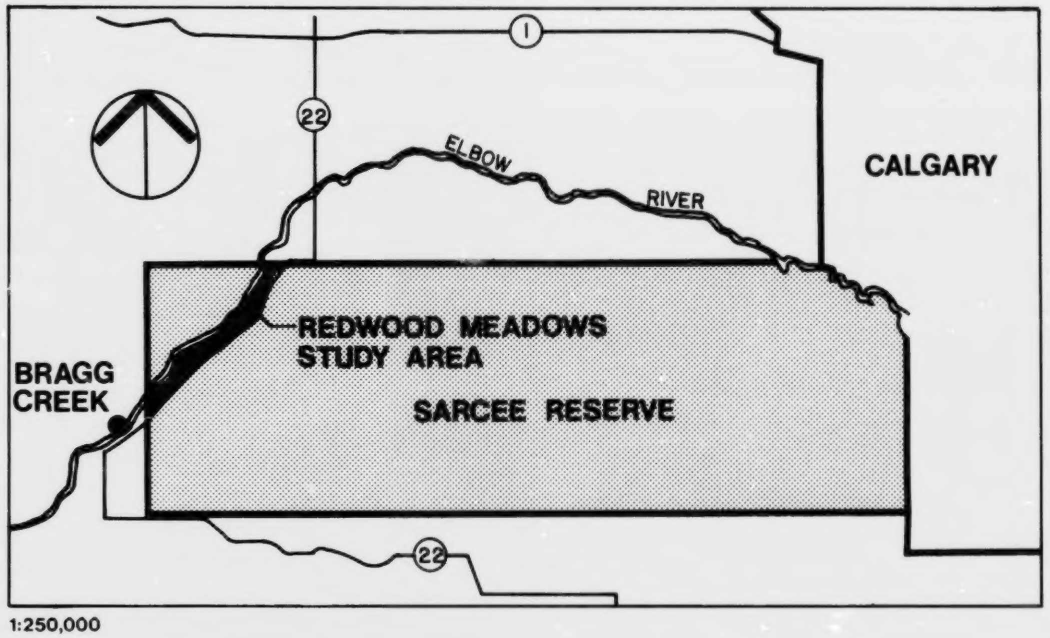

ROCKY MOUNTAINS FOREST RESERVE
22
2
AIRDRIE
COCHRANE
BOW RIVER
1
CALGARY
1
SARCEE RESERVE
BRAGG CREEK
ELBOW RIVER
22
2
OKOTOKS
BLACK DIAMOND
ROCKY MOUNTAINS FOREST RESERVE
1:750,000

EXHIBIT 1.2

LOCAL SETTING


1
22
ELBOW
RIVER
CALGARY
BRAGG CREEK
REDWOOD MEADOWS STUDY AREA
SARCEE RESERVE
22
1:250,000

1.2 BACKGROUND

As part of an ongoing program to generate new employment opportunities and improve the economy of the Band, the Redwood Meadows Community Project was undertaken. Working with the support of the Federal Department of Indian Affairs, the Sarcee Developments Ltd. Company was formed to develop and manage the project. Some 415 hectares of land was surrendered by the Band to the Crown, which in turn leased the land to Sarcee Developments Ltd. This procedure subsequently allowed the company to proceed with construction of a comprehensive utility servicing system, an 18 hole championship golf course, and the planning and sub-leasing of housing sites adjacent to the golf course. The success of the first development phase has confirmed the demand for this type of high amenity, relatively low density community. As a result, Sarcee Developments Ltd. has initiated this study to develop a detailed Community Master Plan for the entire area and to identify the boundary and design for construction of future development phases.

1.3 EMPLOYMENT OPPORTUNITIES FOR THE SARCEE PEOPLE

In addition to the revenue gained through land leases, the project will also provide a range of employment opportunities both in the design and construction stages and in the operation and maintenance of the community. As the population develops, retail and service outlets will become economically feasible and it is envisaged that these would be owned and staffed by Sarcees. The Band has undertaken a training program to help prepare Sarcee residents to take advantage of these employment opportunities.

2.0 LANDSCAPE RESOURCES

2.1 GENERAL ASSESSMENT

2.1.1 Drainage

Due to the study area's location adjacent to the south bank of the Elbow River, it was necessary to carry out a detailed investigation of the subsurface material and the groundwater conditions to determine possible construction constraints. Klohn Leonoff Consultants Ltd. were commissioned to undertake a test hole drilling program and to monitor the groundwater conditions by installing standpipe piezometers. A summary of the test hole results is included with the analysis information for each area. A more detailed discussion of the findings to date is found in Section 5.3.3. When piezometer recordings are completed in early 1981, a final statement on the implications of groundwater on development will be prepared. The consultant's recommendations for construction methods and assessment of flooding and erosion along the Elbow River are contained in Sections 2.2 and 2.3.

A surface investigation was undertaken by DeLCan staff to identify and map possible development constraints. The initial topographic and drainage analysis was carried out using aerial photography and contour mapping to plot the main channels and depressions which were created during the geological development of the valley and flood plain. An on-site survey was used to check the nature of the channels, to note any standing water, and generally to record the degree of constraint which a channel may impose on future development in the area. At the time of survey (early May, 1980) some channels were found to have either standing or flowing water. This type of channel will require a development setback and will not normally be included within lots. Other channels appear as small depressions which carry water only in the spring during the period of melting snows. Most have grass covered beds and could be included within future residential lots provided house construction does not encroach on the channel. Many of the minor depressions were not continuous and could be filled, if necessary. As a general guideline it is recommended that:

a) *Lots be set-back a minimum of 5 m from major channels which have standing water or which appear to be active at certain times of the year;*

b) *Lots be set-back a minimum of 2.5 m from other major depressions which could be important for natural storm water runoff; and*

c) *Minor depressions included in lots be noted at the building design stage. Where possible, foundations must not be located directly over the depression unless a test is carried out to ensure that the base material is stable and has an adequate bearing capacity. If minor channels are filled, checks should be made to ensure that localized ponding does not occur during the spring runoff period that may cause problems on adjacent lots.*

2.1.2 Existing Vegetation

The majority of the study area is covered by mature spruce trees. The density of growth is fairly uniform but there are some natural clearings and man-made cut lines which provide a contrast to the heavy tree growth. The undergrowth varies from short grasses to thick brush. Close to the present River channel and in the area covered by the 1923 flood the tree growth is characterized by stands of immature poplar and shrubs. In most areas the 1:100 year flood plain is clearly defined by the change in vegetation. A more comprehensive summary of the existing environment within and surrounding the development site is contained in Section 5.0.

As in Phase I of the Redwood Meadows development, some tree clearing will be essential to allow road and house construction. However, clearing should be kept to a minimum in order that privacy and amenity can be retained within any future development.

2.2 FLOODING AND EROSION PROTECTION

2.2.1 Dyke Location

In 1973 the Department of Regional and Economic Expansion - Prairie Farm Rehabilitation Administration Engineering Services (PFRA), prepared a report entitled: Probability of Flooding and Potential Erosion in the Elbow River Below Bragg Creek. The study addressed the potential flooding problems which may affect the Redwood Meadows site.

One important factor used in the assessment was the level and extent of land inundation resulting from the 1923 flood, which was estimated to have a probability of return in any one year of 1 percent. This flood occurrence is commonly known as the 1:100 year flood.

The PFRA study concluded that without dyke protection, flood waters could inundate much of the flood plain area both in the study area and above Redwood Meadows in the Hamlet of Bragg Creek.

After subsequent studies by Northwest Hydraulic Consultants Ltd. and PFRA, a dyke location was recommended which followed approximately the line of the 1923 flood[1]. By using this alignment, protection could be given from even a 1:500 year magnitude flood and still provide a dyke which was both economic to construct and would not require continuous riprap or armouring. Transverse dykes constructed at right angles to the river dyke were also recommended to prevent continuous flows behind the dyke should the main dyke be breached.

A review of the existing dyke serving the Phase I development area is contained in the report entitled: Redwood Meadows Geotechnical Investigation, Klohn Leonoff Consultants Ltd., May 1980.

Working with the approximate alignments provided by the PFRA study, each analysis area was studied in detail and a dyke location selected which would yield the most developable land while maintaining an alignment close to the 1:100 year flood level. Rip rap should only be required at a few critical points along the dyke.

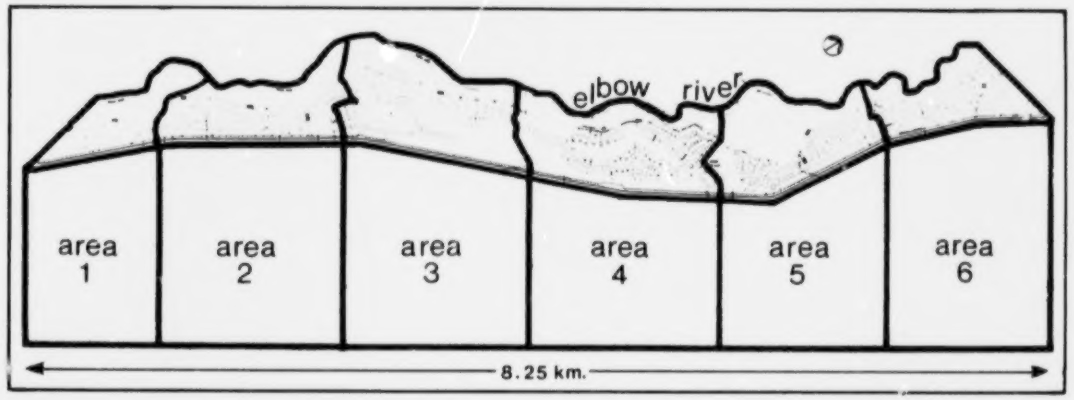
2.2.1 Developable Land

Once the dyke location was confirmed, the land area between the outside of the dyke and the gas line right-of-way adjacent to Highway 22 was calculated. This total area was considered to be the gross developable area (GDA). Any major development constraints such as drainage channels or utility right-of-way were subtracted from this total to provide an estimate of the total Net Developable Area (NDA) in the study area and within each defined area of the total site.

For the purpose of detailed analysis and mapping, the study area has been divided into six smaller areas, as shown on Exhibit 2.1. A summary of the main findings in each area follows.

EXHIBIT 2.1

ANALYSIS KEY PLAN



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[1] *Northwest Hydraulic Consultants Ltd., "Report to Department of Indian Affairs and Northern Development", July, 1975.*

2.3 STUDY AREA ANALYSIS

2.3.1 Area 1

TABLE 2.1

AREA 1
DATA SUMMARY

Total Area[1]	=	91.1 a (36.9 ha)
Flood Plain Area[2]	=	42 a (17 ha)
Gross Developable Area[3]	=	54.1 a (21.9 ha)
Major Development Constraints	=	7.9 a (3.2 ha)
Net Developable Area	=	46.2 a (18.7 ha)
Length of River Dyke Proposed = 610 m	=	3.0 a (1.2 ha)
Length of Transverse Dyke Proposed = 425 m	=	2.1 a (0.9 ha)

[1] Total Area includes area of river dyke right-of-way.
[2] Flood Plain Area refers to land between river dyke and the Elbow River.
[3] Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.

Area 1 lies on the west boundary of the study area adjacent to the Hamlet of Bragg Creek. The area is bounded by the Elbow River in the north-west and Highway 22 in the south-east.

The division between the flood plain and the land considered suitable for development is formed by the proposed dyke alignment. Generally, this alignment has been kept approximately 20 metres inside the tree line which delineates the extent of previous floods up to the 1:100 year magnitude. A transverse dyke is proposed along the west boundary to prevent possible flooding from inundation upstream of Redwood Meadows. The flood plain is characterized by stands of aspen and poplar while further east the tree growth is primarily mature coniferous forest.

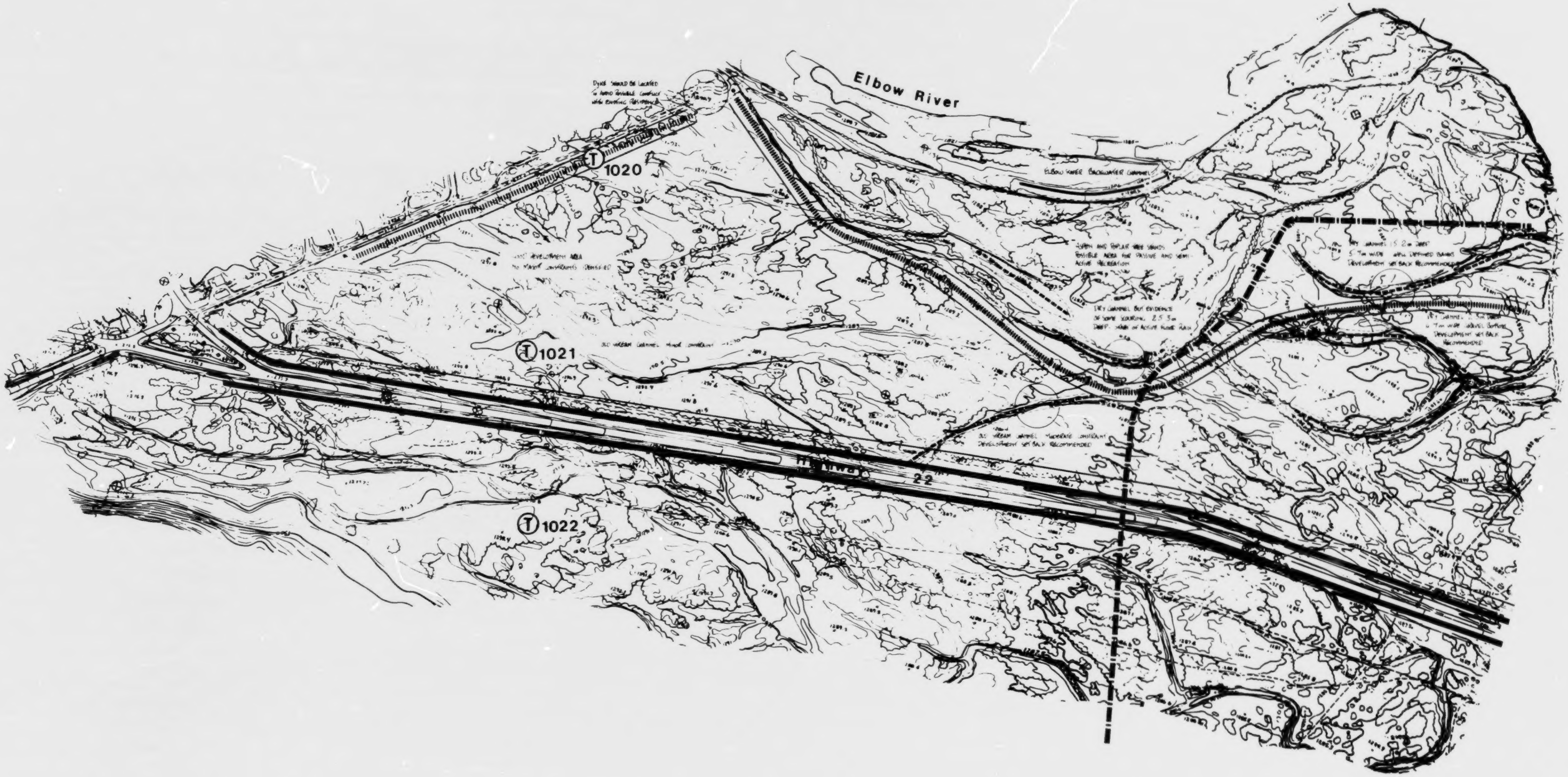
The proposed development area east of the dyke is relatively free from major physical constraints. Those that do exist are shown on Map 2.1.

Table 2.2 provides a summary of the test hole records for Area 1.

TABLE 2.2

AREA 1
TEST HOLE READINGS

Test Hole	Groundwater During Drilling	Water Level Reading May 6 & 29 '80		Deposits Under Topsoil (depth when encountered)
1020	no	2.4 m	1.85 m	Sand and Gravel (0.15 m) Shale (2.5 m)
1021	no	4.8 m	4.55 m	Gravel (0.1 m) Sand and Gravel (4.4 m) Shale (5.2 m)


Elbow River
Dyke should be located to avoid possible conflict with existing residences
1020
Elbow River backwater channel
Aspen and poplar tree stands possible area for passive and semi-active recreation
Dry channel but evidence of some scouring 2.5 3m deep. Part of active flood plain
Dry channel 1.5 2m deep 5-7m wide well defined banks development set back recommended
Dry channel 1.5m deep 6-7m wide gravel bottom development set back recommended
Good development area no major constraints identified
Old stream channel minor constraint
1021
Old stream channel moderate constraint development set back recommended
Highway 22
1022

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2.1

0 50 100 m

REDWOOD MEADOWS MASTER PLAN

AREA 1 ANALYSIS

2.3.2 Area 2

TABLE 2.3

AREA 2
DATA SUMMARY

Total Area[1]	=	155.6 a (63.0 ha)
Flood Plain Area[2]	=	39.9 a (16.2 ha)
Gross Developable Area[3]	=	115.6 a (46.8 ha)
Major Development Constraints	=	18.3 a (7.4 ha)
Net Developable Area	=	97.3 a (39.4 ha)
Length of River Dyke Proposed = 1660 m	=	8.2 a (3.3 ha)
Length of Transverse Dyke Proposed = 296 m	=	1.5 a (0.6 ha)

---

[1] Total Area includes area of river dyke right-of-way.

[2] Flood Plain Area refers to land between river dyke and the Elbow River.

[3] Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.

The division between Area 1 and Area 2 lies at a point where the flood plain widens out and the proposed dyke alignment lies within 100 metres of Highway 22. Further north the potentially developable land widens out to over 300 metres but there are a number of major channels, as shown on Map 2.2, which have influenced the design of lots and roadways in the area. Although most of the channels were dry at the time of survey they may be water filled during spring run-off and carry natural storm water flows at other times of the year. Whenever possible the continuous channels have been retained or at least linked to a proposed road ditch system to ensure continuity of storm water flow. In some locations where the channels are not continuous they could be filled to allow better use of the land for development.

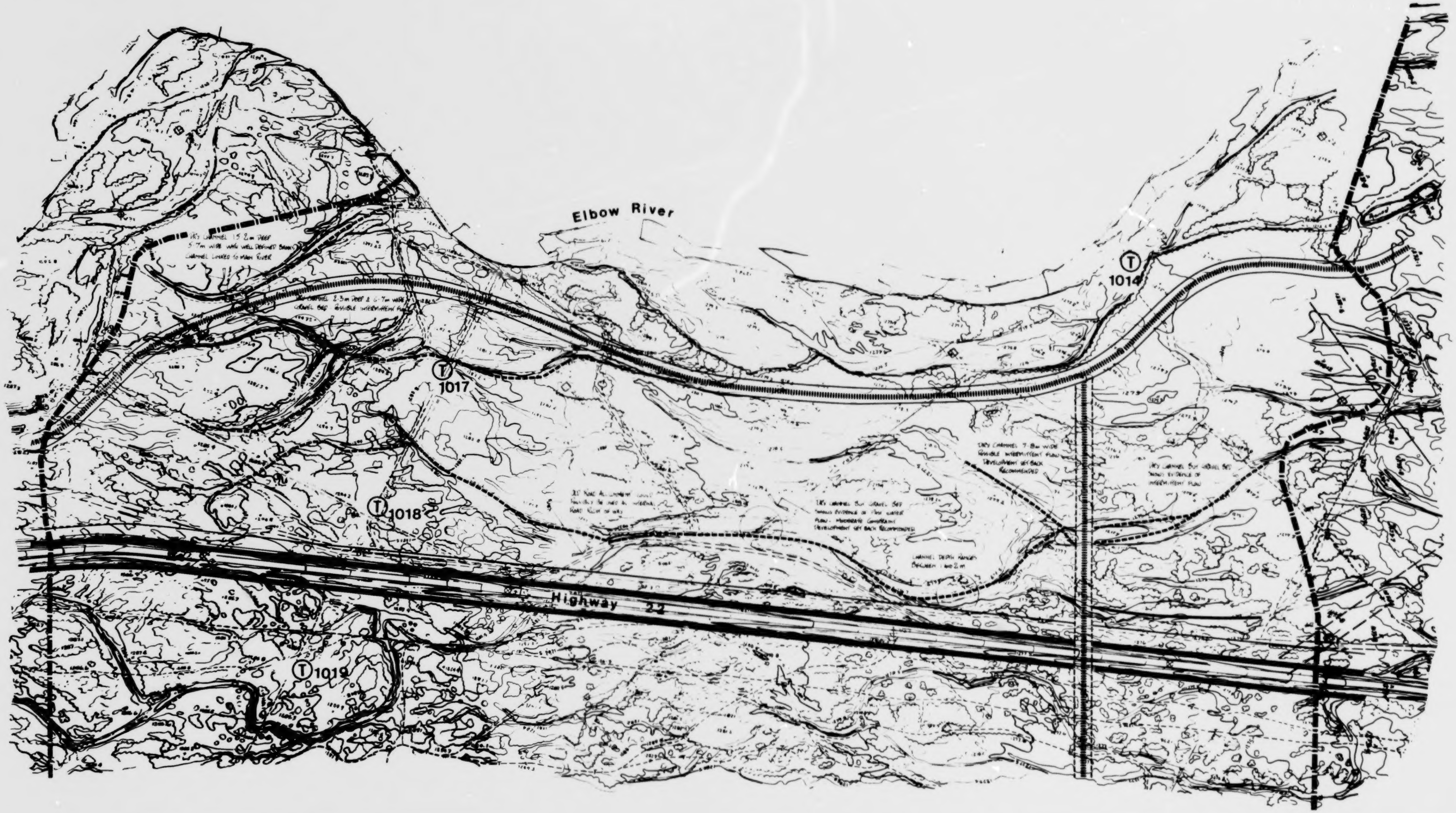
Adjacent to Highway 22 an old road highway bed was identified but it was concluded that its location was not suitable for use in any future road system. The proposed east-west transverse dyke is designed to control possible overflow from the main dyke would run parallel to and approximately 200 metres from the east boundary of Area 2.

The test hole records for Area 2 are summarized in the following Table 2.4.

TABLE 2.4

AREA 2
TEST HOLE READINGS

Test Hole	Groundwater During Drilling	Water Level Reading May 6 & 29 '80	Deposits Under Topsoil (depth when encountered)
1014	2.2 m	1.8 m 1.4 m (May 28)	Sand and Gravel (0.1 m) - fine to coarse Sand and Gravel (2.0 m) - medium to coarse Silt and Clay Shale (5.0 m)
1017	7.1 m	4.2 m 3.5 m	Sand and Gravel (0.9 m) Shale (7.5 m)
1018	no	dry, dry	Sand and Gravel (0.2 m) Shale (6.0 m)


Elbow River
DRY CHANNEL 1.5-2 m DEEP
5-7 m WIDE WITH WELL DEFINED BANKS
CHANNEL LINKED TO MAIN RIVER
DRY CHANNEL 2-3 m DEEP & 6-7 m WIDE
GRAVEL BED - POSSIBLE INTERMITTENT FLOW
T 1014
T 1017
T 1018
T 1019
20' ROAD ALLOWANCE COULD
POSSIBLY BE USED AS INTERNAL
ROAD RIGHT OF WAY
DRY CHANNEL BUT GRAVEL BED
SHOWS EVIDENCE OF PAST WATER
FLOW - MODERATE CONSTRAINT
DEVELOPMENT SET BACK RECOMMENDED
CHANNEL DEPTH RANGES
BETWEEN 1 AND 2 m
DRY CHANNEL 7-8 m WIDE
POSSIBLE INTERMITTENT FLOW
DEVELOPMENT SET BACK
RECOMMENDED
DRY CHANNEL BUT GRAVEL BED
SHOWS EVIDENCE OF
INTERMITTENT FLOW
Highway 22

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2.2

0 50 100 m

REDWOOD MEADOWS MASTER PLAN

AREA 2 ANALYSIS

2.3.3 Area 3

TABLE 2.5

AREA 3
DATA SUMMARY

Total Area[1] = 247.5 a (100.2 ha)

Flood Plain Area[2] = 49.8 a (20.2 ha)

Gross Developable Area[3] = 197.6 a (80.0 ha)

Major Development Constraints = Golf Course + Topo Constraints = 85.9 a (34.8 ha)

Net Developable Area = 111.7 a (45.2 ha)

Length of River Dyke Proposed = 1515 m = 7.5 a (3.0 ha)

---

[1] Total Area includes area of river dyke right-of-way.

[2] Flood Plain Area refers to land between river dyke and the Elbow River.

[3] Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.

Area 3 is located south-west of the Phase 1 development area presently under construction. The area includes holes 10 to 18 of the Redwood Meadows Golf Course. As a result, the development area has been integrated into the golf course layout in such a way that the residents will benefit from the amenity aspect without conflicting with the golf course operation.

The golf course becomes the major physical constraint to development, however, it also becomes a valuable asset for design of the area. Upon discussion with the golf course Manager, development set back limits from the main fairways were drawn to avoid any serious "golf ball hazard" for future residents in this area.

Other development constraints include some water channels totalling about 560 metres in length at the south-west corner of this area. A lotting set back of 5 metres from the banks is shown. A 200 metre dry depression can also be found at the south end, about 80 metres from the Highway. Map 2.3 identifies the area's landscape resources.

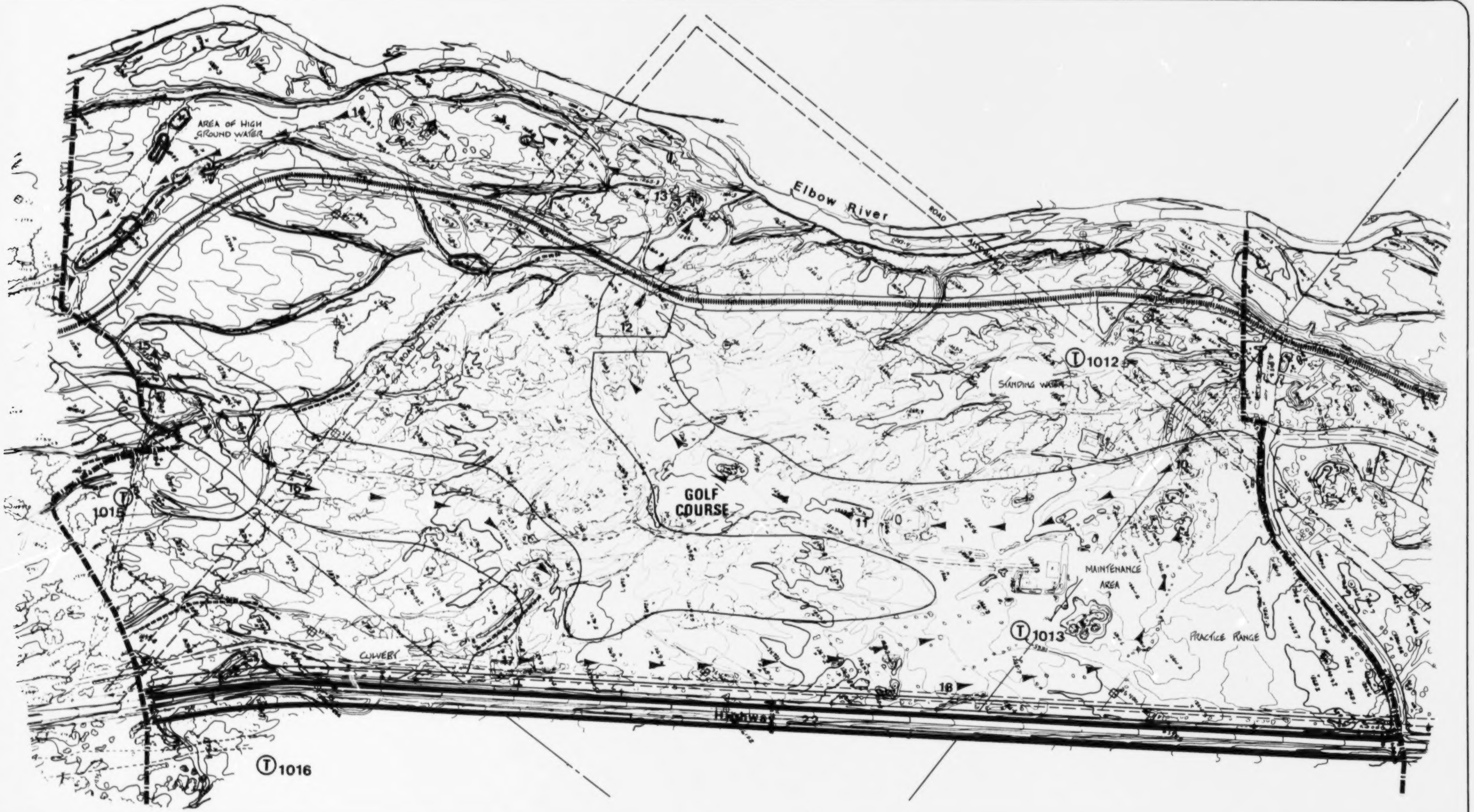
Another topographical constraint in this section is the generally high ground water level especially in the area directly to the east of the proposed dyke. In these areas it may be necessary to restrict the development of housing with basements.

Three test holes are located in this area. The following table summarizes the findings.

TABLE 2.6

AREA 3
TEST HOLE READINGS

Test Hole	Groundwater During Drilling	Water Level Reading May 6 & 29 '80	Deposits Under Topsoil (depth when encountered)
1012	no	2.1 m 1.9 m	Sand and Gravel (0.5 m) Clayey Siltstone (4.0 m)
1013	no	3.45 m 3.05 m	Gravel and Sand (0.3 m) - with some cobbles Sand and Gravel (3.5 m) - with little silt and clay
1015	2.0 m	1.8 m 1.5 m	Sand and Gravel (0.3 m) - fine to coarse grained Sand and Gravel (3.0 m) - medium to coarse grained Siltstone and shale (5.6 m)


AREA OF HIGH GROUND WATER
14
13
Elbow River
ROAD ALLOWANCE
ROAD ALLOWANCE
12
①1012
STANDING WATER
15
①1015
GOLF COURSE
11
MAINTENANCE AREA
①1013
PRACTICE RANGE
CULVERT
16
Highway 22
①1016

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2.3

0 50 100 m

REDWOOD MEADOWS MASTER PLAN

AREA 3 ANALYSIS

2.3.4 Area 4

TABLE 2.7

AREA 4
DATA SUMMARY

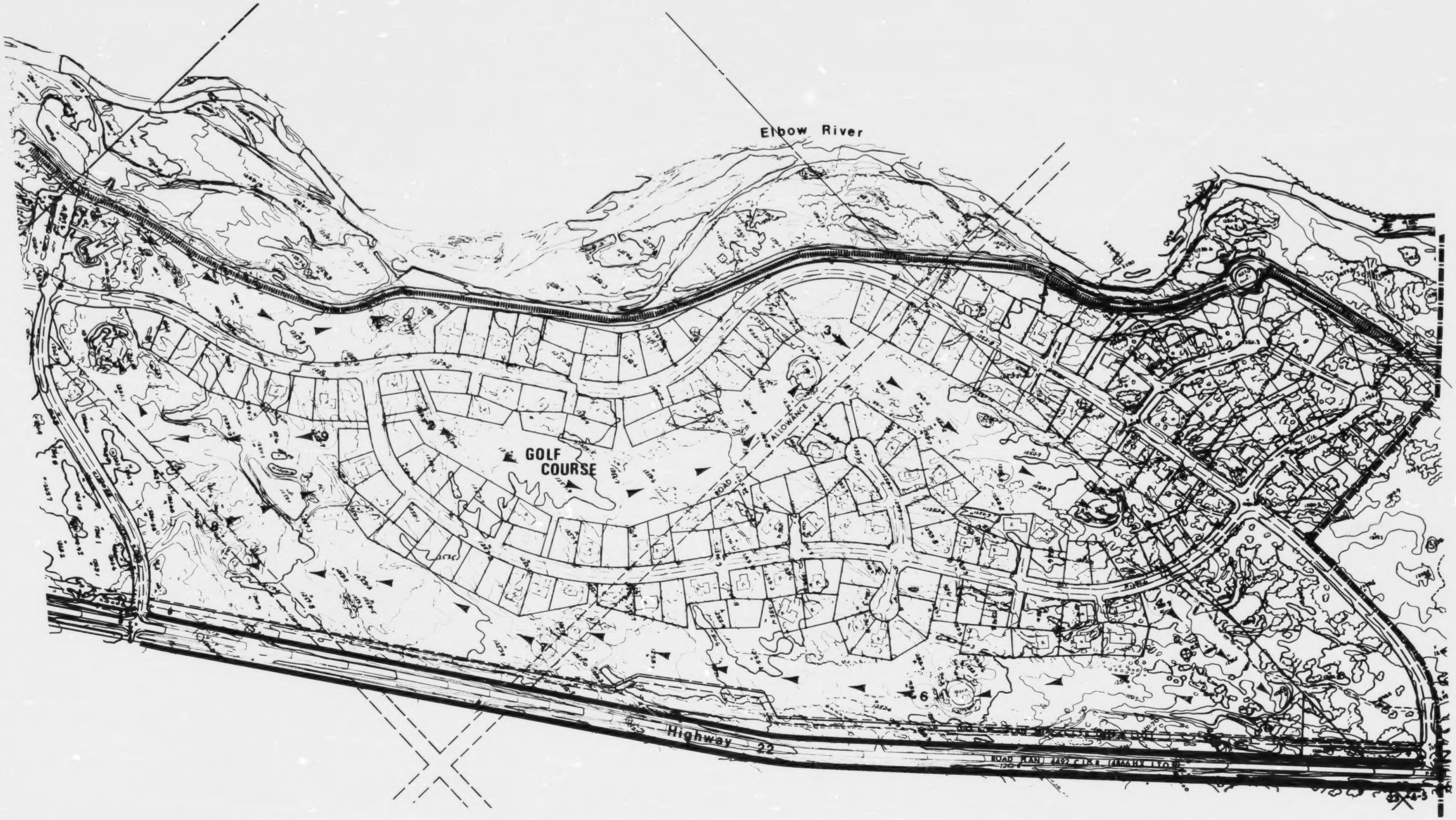
Total Area[1]	=	229.7 a (93.0 ha)
Flood Plain Area[2]	=	32.6 a (13.2 ha)
Gross Developable Area[3]	=	197.1 a (79.8 ha)
Major Development Constraints	=	Golf Course + Dyke = 84.2 a (34.1 ha)
Net Developable Area	=	112.9 a (45.7 ha)
Length of River Dyke Existing =1800 m	=	8.9 a (3.6 ha)

[1] Total Area includes area of river dyke right-of-way.

[2] Flood Plain Area refers to land between river dyke and the Elbow River.

[3] Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.

Area 4 of the Master Plan includes the existing developed portion of Redwood Meadows. Because the area is already planned and building construction has been underway for several years, a physical analysis and test hole investigation was not carried out as part of the current study. A description of the existing land uses and servicing pattern for Area 4 is contained in Section 3.0 and 4.0 dealing with the overall master plan and servicing requirements.


Elbow River
3
ROAD ALLOWANCE
9
GOLF COURSE
8
6
7
Highway 22

2.4

REDWOOD MEADOWS MASTER PLAN

AREA 4 ANALYSIS

0 50 100 m

REDWOOD MEADOWS

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2.3.5 Area 5

TABLE 2.8

AREA 5
DATA SUMMARY

Total Area[1] = 190.7 a (77.2 ha)

Flood Plain Area[2] = 81.5 a (33 ha)

Gross Developable Area[3] = 109.2 a (42.2 ha)

Major Development Constraints = 5.4 a (2.2 ha)

Net Developable Area = 103.8 a (42.0 ha)

Length of River Dyke Proposed = 1440 m = 7.1 a (2.9 ha)

Length of Transverse Dyke Proposed = 265 m = 1.3 a (0.5 ha)

---

[1] Total Area includes area of river dyke right-of-way.

[2] Flood Plain Area refers to land between river dyke and the Elbow River.

[3] Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.

Almost half of the land in Area 5 falls within the flood plain area. The average depth between Highway 22 and the proposed dyke is approximately 300 metres. In addition to the dyke, two other major development constraints can readily be identified, as shown on Map 2.5. The first is an 8-10 metre wide water filled channel running in a south to north direction. The channel appears to be spring fed and particularly active when the Elbow River water levels are high. The second channel is dry for most of its length but evidence could be seen of standing water resulting from the spring thaw.

It is recommended that lots be set back at least 2.5 metres from the dry channel banks and 5 metres from the areas of standing or running water. Where roads are proposed to cross the channel, culverts should be used to allow the natural drainage to flow. Where the channel intersects with the proposed dyke a culvert with flap gate may be required to prevent the influx of water during flood conditions.

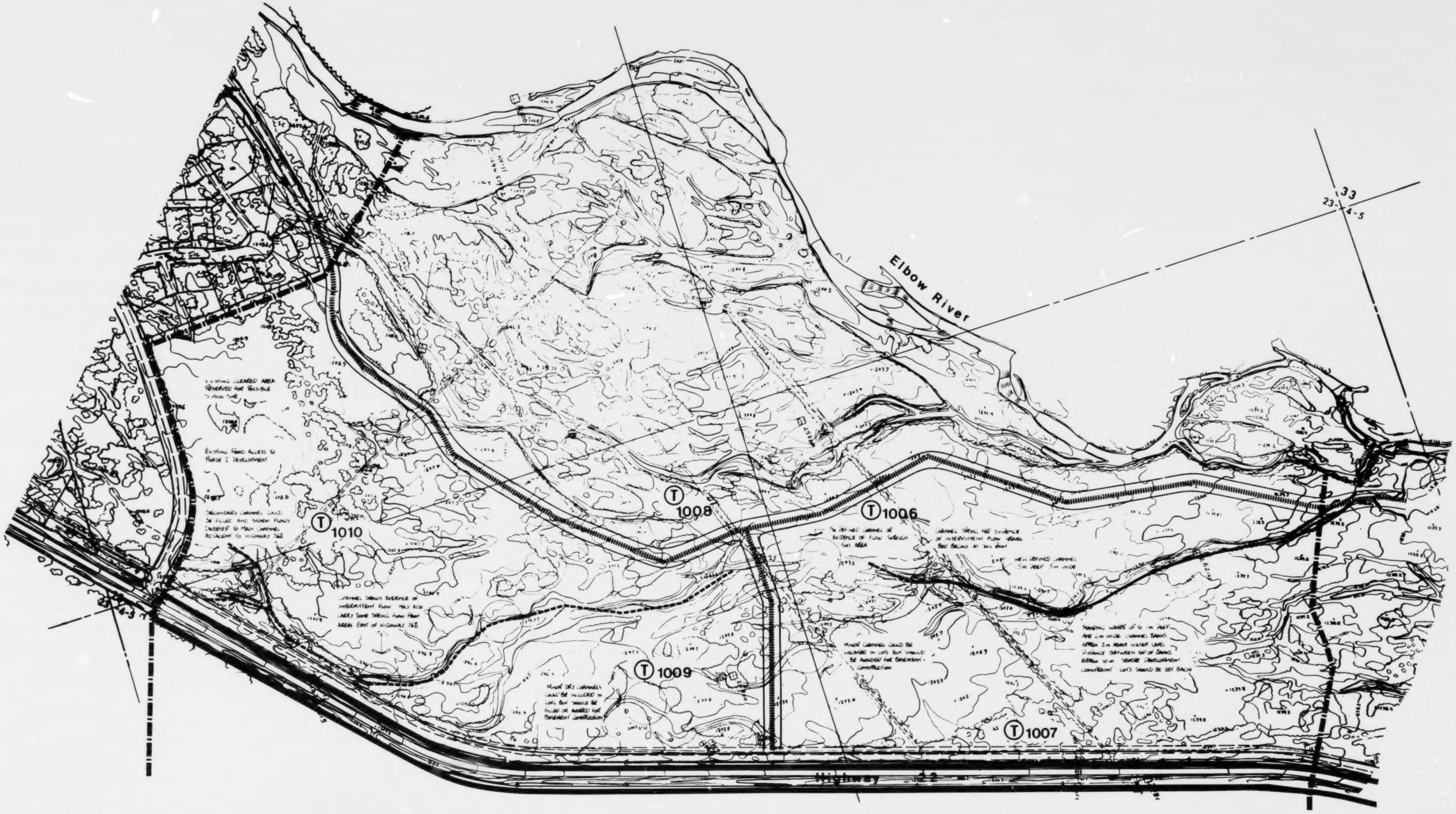
There are also a number of secondary dry channels throughout the area which could be included within lots, but which should be filled or avoided for basement construction. A second transverse dyke is proposed approximately at the centre of the area, again running at right angles to the main dyke.

The following table provides a summary of the test holes in this Area.

TABLE 2.9

AREA 5
TEST HOLE READINGS

Test Hole	Groundwater During Drilling	Water Level Reading May 6 & 29 '80	Deposits Under Topsoil (depth when encountered)
1006	2.5 m	2.1 m 2.05 m	Sand and Gravel (0.2 m) Sand (2.0 m), Gravel (5.0 m) Siltstone (8.5 m)
1007	no	2.7 m 2.6 m	Gravel (0.3 m) Sand and Gravel (3.5 m) Sandstone (6.0 m)
1008	4.6 m	2.8 m 2.1 m (May 28)	Sand and Gravel (0.2 m) Sand (6.0 m), Gravel (7.0 m) Bed rock not encountered during drilling.
1009	no	3.3 m 2.8 m (May 28)	Gravel (0.9 m) Gravel and Sand (5.5 m) Shale (10.5 m)
1010	no	3.15 m 2.5 m (May 28)	Sand and Gravel (1.0 m) Sandstone (7.5 m)
1011	no	4.2 m 2.0 m (May 28)	Gravel and Sand (0.5 m) Sandstone (8.0 m)



Elbow River
Highway 22
33
23-4-5
23-4-5
1010
1008
1006
1009
1007
EXISTING CLEARED AREA RESERVED FOR POSSIBLE SCHOOL SITE
EXISTING ROAD ACCESS TO PHASE I DEVELOPMENT
SECONDARY CHANNEL COULD BE FILLED AND STORM FLOWS DIVERTED TO MAIN CHANNEL ADJACENT TO HIGHWAY 762
CHANNEL SHOWS EVIDENCE OF INTERMITTENT FLOW. MAY ALSO CARRY SOME SPRING FLOW FROM AREAS EAST OF HIGHWAY 762
NO DEFINED CHANNEL OR EVIDENCE OF FLOW THROUGH THIS AREA
CHANNEL SHOWS NO EVIDENCE OF INTERMITTENT FLOW. GRAVEL BED BEGINS AT THIS POINT
WELL DEFINED CHANNEL 5m DEEP 5m WIDE
STANDING WATER UP TO 1m DEEP AND 5m WIDE. CHANNEL BANKS APPROX 2m ABOVE WATER LEVEL. DISTANCE BETWEEN TOP OF BANKS APPROX 10m. SEVERE DEVELOPMENT CONSTRAINT. LOTS SHOULD BE SET BACK
MINOR CHANNEL COULD BE LOCATED IN LOTS BUT SHOULD BE AVOIDED FOR BASEMENT CONSTRUCTION
MINOR DRY CHANNELS COULD BE INCLUDED IN LOTS BUT SHOULD BE FILLED OR AVOIDED FOR BASEMENT CONSTRUCTION

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AREA 5 ANALYSIS

2.3.6 Area 6

TABLE 2.10

AREA 6
DATA SUMMARY

Total Area[1]	=	119.5 a (48.4 ha)
Flood Plain Area[2]	=	14.4 a (5.8 ha)
Gross Developable Area[3]	=	105.1 a (42.6 ha)
Major Development Constraints	=	12.3 a (5.0 ha)
Net Developable Area	=	92.9 a (37.6 ha)
Length of River Dyke Proposed = 1100 m	=	5.4 a (2.2 ha)

[1] Total Area includes area of river dyke right-of-way.

[2] Flood Plain Area refers to land between river dyke and the Elbow River.

[3] Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.

Area 6 borders the northern boundary of Redwood Meadows. Because the proposed dyke is located close to the active River channel, over 80 percent of the area is developable. The dyke alignment is, however, still outside the 1:100 year flood plain.

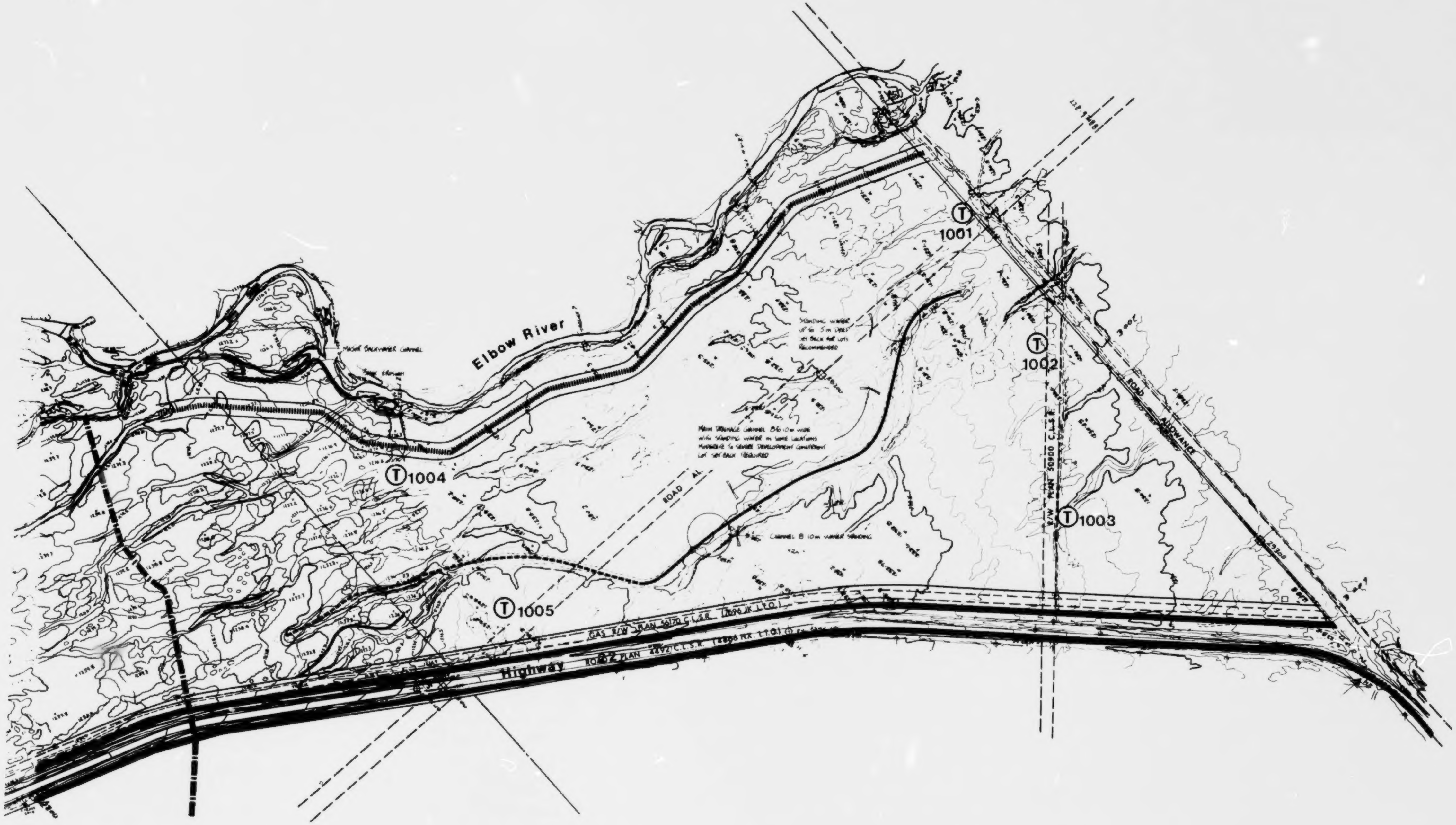
The contour plan and field checks revealed an important drainage channel running almost the entire length of Area 6, as shown on Map 2.6. At the south end, close to Highway 22, the channel was dry but further north some large ponds were found. Although from an amenity point of view these areas of standing water could be an attractive focal point, lots should be set back at least 5 m to avoid bank erosion and to allow pathways and trails to be developed. Again, proposed road crossings should be culverted to allow the drainage of storm water flows. As with all the areas, minor depressions, channels and surface around conditions should be tested prior to lot leasing and building construction to ensure that foundation and drainage problems will not arise.

The 15 m utility right-of-way (Plan 50900) at the north end of Area 6 will also create a design constraint and may form the northern limit of residential lotting. The test hole data for Area 6 is shown below.

TABLE 2.11

AREA 6
TEST HOLE READINGS

Test Hole	Groundwater During Drilling	Water Level Reading May 6 & 29 '80		Deposits Under Topsoil (depth when encountered)
1001	2.0 m	1.3 m	1.0 m	Sand and Gravel (0.5 m) Gravel (2.0 m) Clay and Silt (5.5 m) Bedrock not encountered during drilling.
1002	no	3.6 m	3.65 m	Sand (0.4 m) Sand and Gravel (4.0 m) Shale (8.5 m)
1003	no	4.2 m	4.2 m	Sand (0.4 m) Gravel and Sand (2.0 m) Shale (6.5 m)
1004	Deleted due to access problems			
1005	no	2.1 m	2.0 m	Gravel and Sand (0.3 m) Sandstone (4.5 m)


Elbow River
MAJOR BACKWATER CHANNEL
BANK EROSION
STANDING WATER UP TO .5 m DEEP SET BACK FOR LOTS RECOMMENDED
MAIN DRAINAGE CHANNEL 8 TO 10 m WIDE WITH STANDING WATER IN SOME LOCATIONS MODERATE TO SEVERE DEVELOPMENT CONSTRAINT LOT SET BACK REQUIRED
CHANNEL 8 10 m WATER STANDING
ROAD AL.
ROAD ALLOWANCE
GAS R/W PLAN 5670 C.L.S.R. (7896 JK L.T.O.)
ROAD PLAN 4892 C.L.S.R. (4806 HX L.T.O.)
Highway 22
T 1001
T 1002
T 1003
T 1004
T 1005

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AREA 6 ANALYSIS

In summary, Table 2.12 outlines the overall statistics relating to the physical analysis of the site and total lengths of dykes proposed.

TABLE 2.12

SUMMARY
SITE ANALYSIS AND PROPOSED DYKE LENGTHS

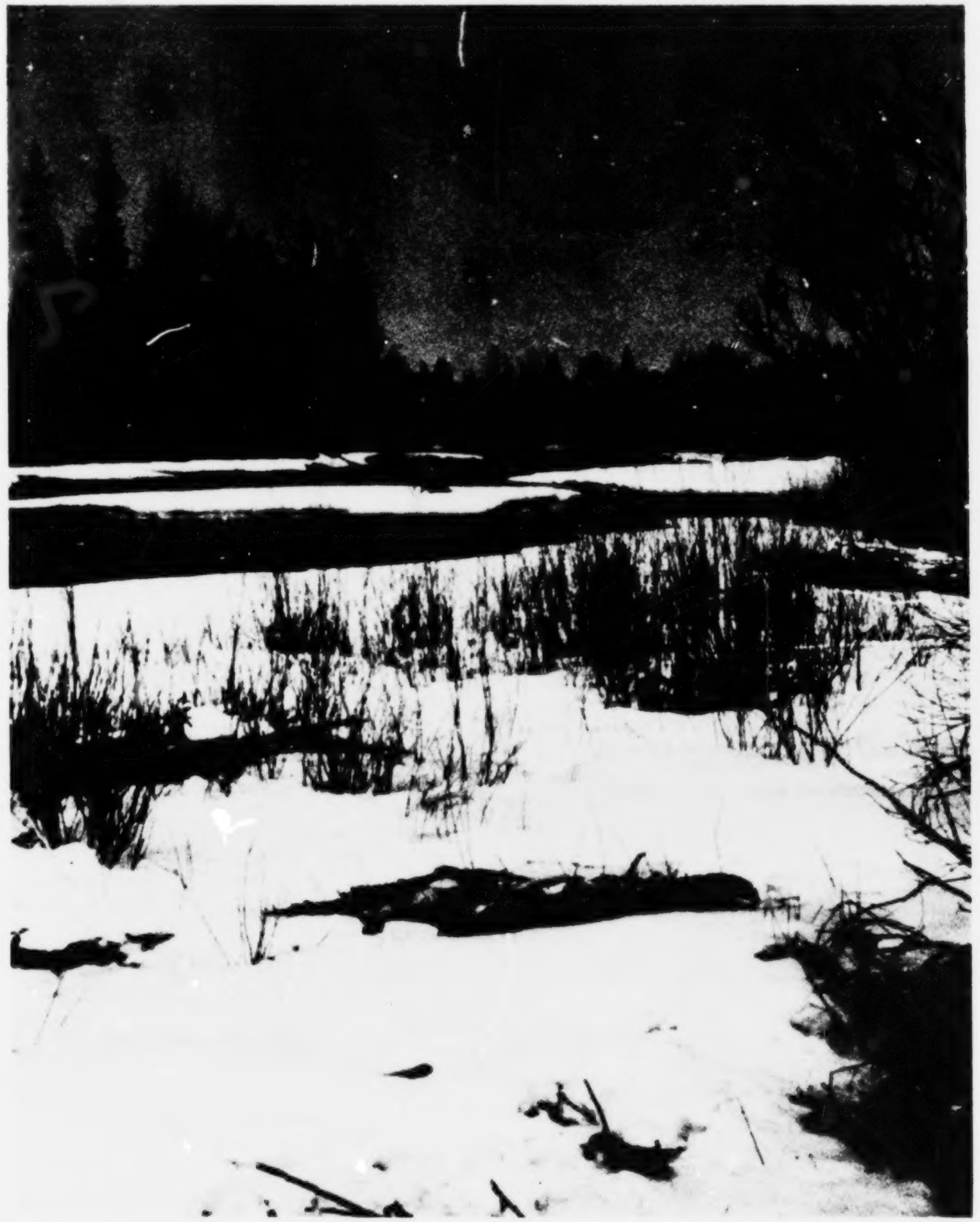
Total Area[1]	=	*1047.5 a (424.1 ha)*
Flood Plain Area[2]	=	*260.3 a (105.4 ha)*
Gross Developable Area[3]	=	*782.2 a (316.7 ha)*
Major Development Constraints	=	*222.4 a (90.1 ha)*
Net Developable Area	=	*559.8 a (226.6 ha)*
Length of River Dyke	=	*8125 m (includes 1800 m existing)*
Length of Transverse Dykes	=	*986 m*

---

[1] *Total Area includes area of river dyke right-of-way.*

[2] *Flood Plain Area refers to land between river dyke and the Elbow River.*

[3] *Gross Developable Area (GDA) refers to land between the outside of the dyke and the gas utility right-of-way along Highway 22.*



3

MASTER PLAN

3.0 MASTER PLAN

3.1 OVERALL DEVELOPMENT CONCEPT

3.1.1 Introduction

The Master Plan has been prepared in relation to the landscape resources outlined in Section 2.0. The major factors which have influenced the design are the:

a) Proposed dyke location and 1:100 year flood plain;

b) Existing Highway No. 22;

c) Natural drainage channels throughout the area; and,

d) Existing 18 hole golf course and Phase 1 residential development.

Although some of the above factors are considered as planning constraints, the golf course and natural features provide an opportunity for variation in lotting patterns and road configuration which will contribute greatly to the overall character of the area. The Redwood Meadows Community Master Plan is depicted on Map 3.1.

3.1.2 Housing and Lotting Pattern

The majority of single family lots range in size from 0.3 to 0.5 acres (1200 m^2 to 2000 m^2). In some locations the distance between the proposed dyke and Highway 22 limits the lotting pattern to frontage along the main internal neighbourhood collector road. However, in most places, the developable area is wide enough to allow the incorporation of cul-de-sacs, loop roads, and crescents. The main objective has been to provide a variety of lot sizes and locations ranging from estate lots adjacent to the golf course to secluded parcels within quiet cul-de-sacs. Where feasible, the major drainage channels, whether active or inactive, have been retained to help carry major storm water flows and to provide walkway links between individual development clusters.

In addition to the single family lots, 4 areas of medium density, multiple family housing have been included. It is intended that these areas be designed to high architectural standards with proper landscaping and careful site planning to take advantage of the existing amenity and natural vegetation. The multiple family clusters have been located close to the access roads to Highway 22 in an effort to reduce traffic volumes on the internal road system.

3.1.3. Population and Density

a) Population

The projected population for Redwood Meadows has been based on the present occupancy rate for the single family homes in Phase 1 of 4.0 persons per dwelling. This figure is somewhat higher than the Alberta average and indicates an obvious attraction to the area of people who are family orientated. The Master Plan identifies 876 single family lots and 179 multiple family units. Occupancy rates for multiple family dwellings have been calculated on the basis of 3 persons per unit. The overall population projection is summarized on Table 3.1.

TABLE 3.1

POPULATION PROJECTIONS

	Single Family	Multiple Family[1]	Total
Number of Dwelling Units	876	179	1,055
Population Projection[2] All Phases	3,504	537	4,041

[1] Based on an average density of 15 units/hectare (6 units/acre).

[2] Based on 4.0 persons per single family dwelling and 3.0 persons per multiple family dwelling.

b) Density

The philosophy behind the Redwood Meadows development has been to provide a low density high amenity community. Based on the land area between the proposed dyke and Highway 22, the average density is 1.3 dwelling units per acre (3.3 units/hectare). The population density using the same land area is 5.1 persons per acre (12.8 persons/hectare). As a *comparison, an average City of Calgary neighbourhood may have a density of between 18 and 22 persons per acre (45-55 persons per hectare).*

In Redwood Meadows the multiple family clusters have been planned with a density of approximately 6 units per net acre (14.8 units/hectare). Again, this is a low density for this type of housing but it is considered to be in-keeping with the overall objective to provide a high quality residential setting without destroying the natural beauty of the site.

Table 3.2 provides a summary of the density calculations.

TABLE 3.2

DENSITY OF DEVELOPMENT

	Units/Acre	(Hectare)	Persons/Acre	(Hectare)
Overall Site Area Density[1]	1	(2.5)	3.8	(9.5)
Gross Developable Area Density[2]	1.3	(3.3)	5.1	(12.8)
Net Area Density[3]	2.6	(6.4)	10	(24.7)

[1] The total land area between the river and Highway 22.

[2] The land area between the dyke and Highway 22.

[3] The net land area once land requirements for the golf course, school, parks, shopping facilities, recreation facilities and major physical constraints have been subtracted.

3.1.4 Community Facilities

a) *Education*

Decisions regarding the actual construction and timing of a school in Redwood Meadows are the responsibility of the local School Board. Normally the construction of new facilities is dependent upon: the population living in the area, the rate of population growth, the number of students generated per family, the spare capacity in other schools in the district, and the availability of funds from the Province.

Although the timing of school construction is not easy to predict, there is little doubt that the Redwood Meadows community will have sufficient population to support one school, possibly more. In anticipation of this, a 11.8 acre (4.8 hectare) site for school facilities has been planned central to the community between Areas 4 and 5.

Since the major outdoor recreation facilities have been planned adjacent to the school site on the north side of the dyke, the 11.8 acres within the dyke is available for school buildings, parking, landscaping and informal recreation. As a result, more than one school could be accommodated should the demand arise.

Consideration should also be given to incorporating kindergarten classes either as part of the school complex or in association with the community building in Area 2.

Although it is difficult to anticipate the number of students which may be generated when the community is fully developed, the following Table 3.3 attempts a prediction based on present trends in student generation.

TABLE 3.3

ESTIMATED STUDENT GENERATION[1]

Population	No. of Families	Kindergarten + Elementary	Junior High	Senior High	Total Students
4000	1055	854	338	232	1424

[1] Assuming a student generation of 0.81 students per dwelling - Kindergarten/Elementary, 0.32 - Junior High, and 0. 22 - Senior High. Total of 1.35 students per household. Family generation based upon 3.79 persons average per dwelling unit.

b) Church

While no specific site has been designated in the plan, there nay be the need for church facilities as the population grows. A number of possible sites are proposed including the local shopping centre in Area 1; the Recreation Centres in Areas 2 and 6; and the community shopping centre or school site in Area 5. Other sites may also be feasible. Actual choice of a site will reflect the demand for the facility and design requirements.

c) Recreation and Open Space

i) Outdoor Recreation

Recreation areas can be divided into two basic types, active and passive. Much of the 260 acre (105.2 hectare) flood plain area falls into the passive category; which also includes the Elbow River banks and the natural lands in Area 1 and Area 5 lying outside the proposed dyke. In some locations these flood plain lands incorporate part of the existing golf course and proposed sports fields. However, over 200 acres (80.9 hectares) will be preserved in its natural state, providing an extensive system of trails and walkways linking all parts of the community.

The active recreation facilities include all areas planned for organized games and sports, and include the golf course, athletic field, soccer fields, baseball and softball diamonds and tennis courts. In addition, there are a number of local parks and children's play areas distributed throughout the community. In total, 216 acres (87.4 hectares), 29% of the land within the dyke, is maintained for open space and recreation. Overall, the open space provision, including the passive flood plain and recreation areas, is approximately 49% of the total site.

ii) Recreation Buildings

In addition to the outdoor facilities, the Master Plan proposes the development of two community buildings. The first, located between Areas 1 and 2, could provide recreation facilities including court space for squash and racquetball. The second, located at the north end of Area 6, could include hockey arena and curling rinks.

The existing golf club house is located in Area 4. Additional information on the proposed facilities is provided in the Section 3.2 dealing with each individual development area.

A deliberate attempt has been made to distribute the outdoor and indoor recreation and community facilities throughout the Redwood Meadows Community. This has been done to ensure that some type of facility is within easy reach of all residents and to avoid the severe traffic and parking problems which could arise if all the recreation facilities were located in one area. Undoubtedly, the racquet courts, arena, and curling facilities will be supported in part by individuals and associations outside the Redwood Meadows community. As with the existing golf club house, the recreational buildings would be easily accessible from the Highway without the need for traffic movements through the internal streets.

d) Police, Fire and Administrative Services

Adequate fire protection and police services are essential elements in any community development. As discussed in the section on utilities, the water system has been sized to provide for adequate fire fighting flows. Space for a fire station, police sub-office and community administrative offices has been allowed for in the community shopping centre site.

The fire department should be co-ordinated by a salaried fire chief who can train additional volunteer fire fighters. The fire chief should be given the responsibility of establishing the equipment required and the manpower needed for adequate protection. He would also have a responsibility for educating residents in fire prevention, particularly with regard to open fires in a forested area.

3.1.5 Commercial Facilities

a) Distribution

A total of 9.8 acres (3.59 hectares) of land has been planned for commercial uses. The largest site consisting of approximately 6 acres (2.4 hectares) is located between Areas 4 and 5 and will serve as the main community shopping and administrative centre. The other sites, 2.7 acres (1.1 hectare) and 1.1 acres (.4 hectares) will provide convenience shopping to residents in Areas 1, 2, and 3, which are furthest from the community shopping centre.

b) *Floor Space Provision*

Floor space requirements are difficult to estimate, particularly when the majority of residents will continue to travel daily to Calgary for work and major purchases. The community is not independent in the same way as a town which has its own industrial and employment base. In terms of shopping requirements, Redwood Meadows may act more like a City neighbourhood, with daily or convenience goods and services being purchased at the local community/neighbourhood shopping centre and weekly or monthly purchases being carried out in major Regional Shopping centres such as South Centre and Market Mall. The ultimate population of Redwood Meadows together with the existing population of Bragg Creek will be approximately equal to that of a City neighbourhood although the density will be significantly lower.

Based on neighbourhood commercial standards it is estimated that between 10 and 12.5 square feet (3 - 3.8 m^2) of floor space should be allowed per person. Using an ultimate resident trading population of 4,000 the total commercial area required would be 40,000 - 50,000 square feet (12,200 - 15,250 m^2).

Based on the higher figure, Table 3.4 shows the distribution between the community shopping centre and the local convenience sites.

TABLE 3.4

COMMERCIAL FLOOR SPACE PROJECTIONS

	Square Feet	Square Metres
Community shopping centre (Area 5)	30,650	2,847
Local commercial site (Area 1)	13,750	1,277
Local commercial site (Area 2)	5,600	520

Note, the above figures should be used only as a general guide; the actual development will have to be staged with the population growth. The ultimate success of commercial ventures in Redwood Meadows is dependent upon the quality of goods and services offered and the ability of the businesses to attract trade which would otherwise be lost to Calgary. The population base alone does not guarantee success.

3.1.6 Overall Land Use Summary

Table 3.5 outlines the land use statistics for the overall master plan concept illustrated on Map 3.1. As shown, after the flood plain, dykes, and major development constraints such as the golf course and minor drainage channels are deducted, 559.8 acres or 53.4% of the total site has been identified for urban uses.[1] In total, housing accounts for 305.2 acres or 72.4% of the net developable area. Formal school site, parks, and recreation/community facilities (in addition to the golf course) comprise 53.7 acres, or 9.6% of the developable area. The transportation system comprises 16.2% of this area.

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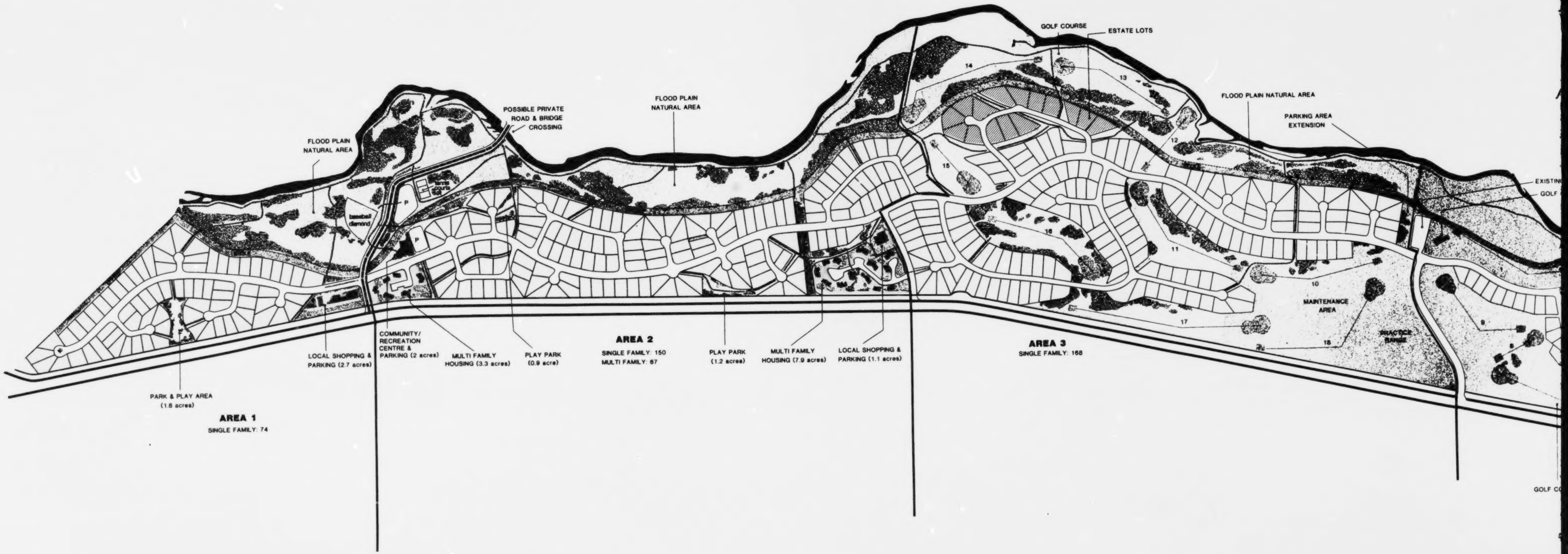
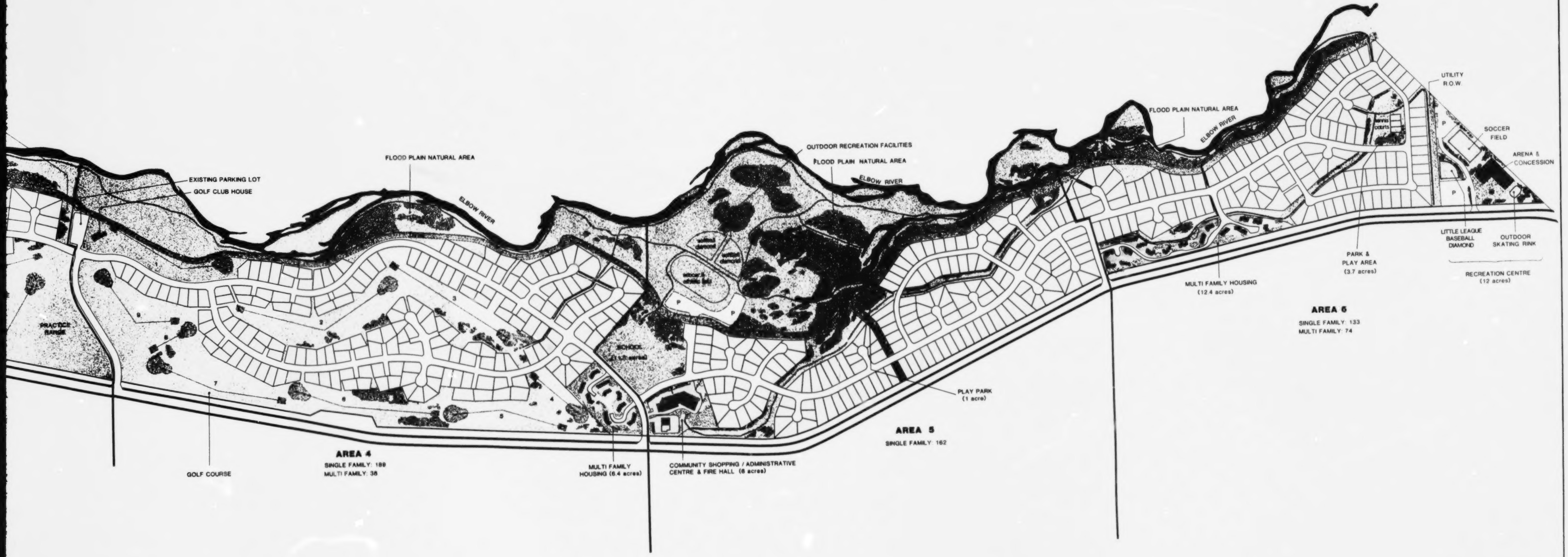
[1] *All figures in the table and preceeding discussion include the existing development phase (Area 4) statistics.*


FLOOD PLAIN NATURAL AREA
POSSIBLE PRIVATE ROAD & BRIDGE CROSSING
FLOOD PLAIN NATURAL AREA
GOLF COURSE
ESTATE LOTS
FLOOD PLAIN NATURAL AREA
PARKING AREA EXTENSION
EXISTIN
GOLF
baseball diamond
tennis courts
P
P
14
13
12
15
16
11
10
17
18
9
8
MAINTENANCE AREA
PRACTICE RANGE
PARK & PLAY AREA (1.8 acres)
AREA 1
SINGLE FAMILY: 74
LOCAL SHOPPING & PARKING (2.7 acres)
COMMUNITY/ RECREATION CENTRE & PARKING (2 acres)
MULTI FAMILY HOUSING (3.3 acres)
PLAY PARK (0.9 acre)
AREA 2
SINGLE FAMILY: 150
MULTI FAMILY: 67
PLAY PARK (1.2 acres)
MULTI FAMILY HOUSING (7.9 acres)
LOCAL SHOPPING & PARKING (1.1 acres)
AREA 3
SINGLE FAMILY: 168
GOLF C


FLOOD PLAIN NATURAL AREA
EXISTING PARKING LOT
GOLF CLUB HOUSE
ELBOW RIVER
PRACTICE RANGE
SCHOOL
P
P
GOLF COURSE
AREA 4
SINGLE FAMILY: 189
MULTI FAMILY: 38
MULTI FAMILY HOUSING (6.4 acres)
COMMUNITY SHOPPING / ADMINISTRATIVE CENTRE & FIRE HALL (8 acres)
OUTDOOR RECREATION FACILITIES
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
PLAY PARK (1 acre)
AREA 5
SINGLE FAMILY: 162
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
tennis courts
MULTI FAMILY HOUSING (12.4 acres)
PARK & PLAY AREA (3.7 acres)
AREA 6
SINGLE FAMILY: 133
MULTI FAMILY: 74
UTILITY R.O.W.
SOCCER FIELD
ARENA & CONCESSION
P
P
LITTLE LEAGUE BASEBALL DIAMOND
OUTDOOR SKATING RINK
RECREATION CENTRE (12 acres)

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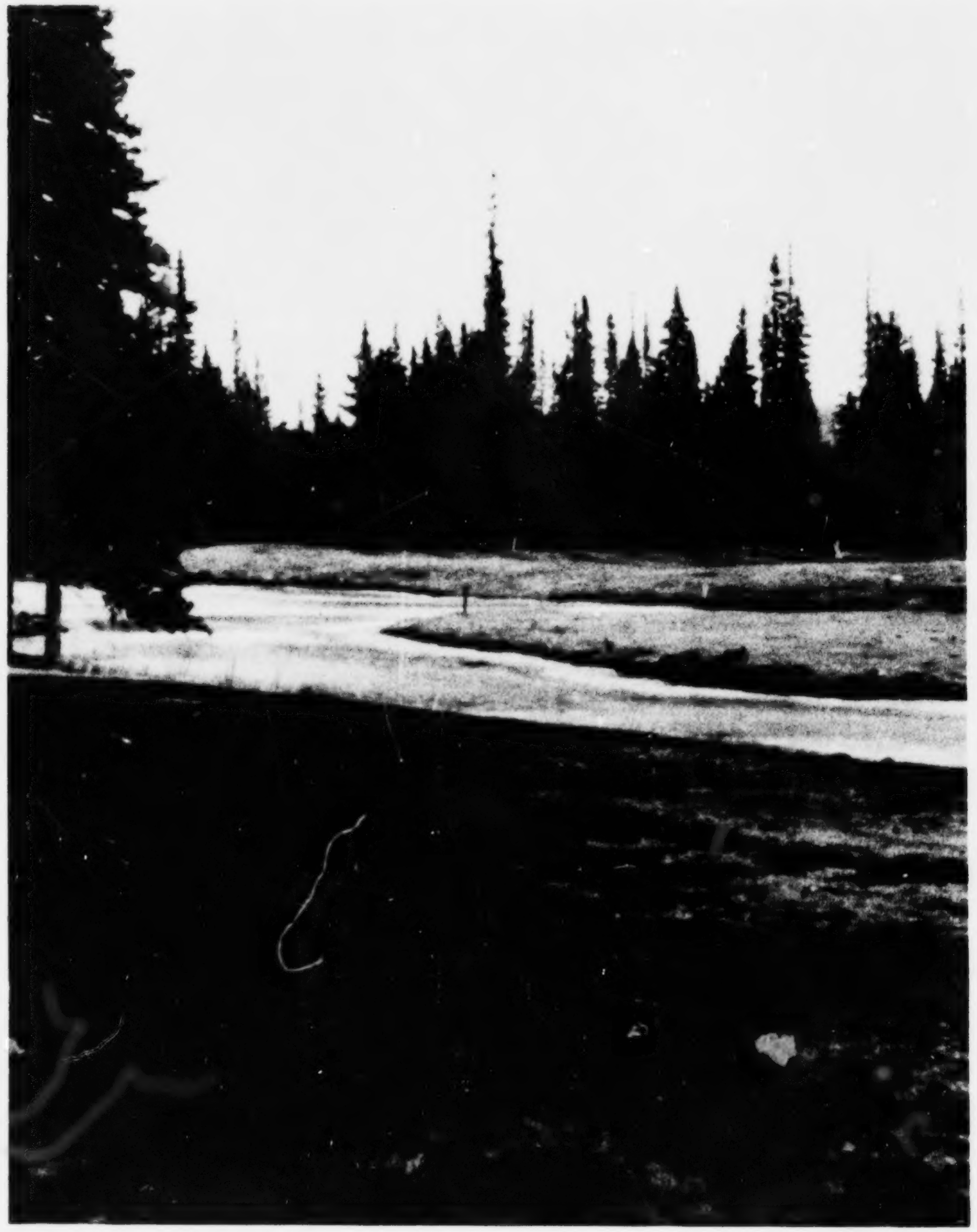
COMMUNITY MASTER PLAN

TABLE 3.5

OVERALL LAND USE SUMMARY

	Area	Percentage of Net Developable Area
Total Area	*1047.5 a (421.1 ha.)*	-
Net Developable Area	*559.8 a (276.6 ha.)*	*100.0*
Single Family Housing *- No. of Lots: 876*	*375.2 a (151.9 ha.)*	*67.0*
Multiple Family Housing *- No. of Units: 179*	*30.0 a (12.2 ha.)*	*5.4*
Commercial	*9.8 a (4.0 ha.)*	*1.8*
Parks and Walkways	*27.9 a (11.3 ha.)*	*5.0*
Recreation/Community Facilities	*14.0 a (5.7 ha.)*	*2.5*
School Site	*11.8 a (4.8 ha.)*	*2.1*
Roads *- 20 m R/W Length: 11250 m (55.6 a/22.5 ha.)* *- 15 m R/W Length: 8870 m (34.4 a/13.9 ha.)* *- Parking Area Extension: (1.1 a/0.4 ha.)*		
Total Roads	*91.1 a (36.8 ha.)*	*16.2*



3.2 AREA LAND USE PLANS

3.2.1 Area 1

TABLE 3.6

AREA 1
LAND USE SUMMARY

	Area	Percentage of Net Developable Area
Total Area	96.1 a (38.9 ha.)	-
Net Developable Area	46.2 a (18.7 ha.)	100.0
Single Family Housing - No. of Lots: 74	32.0 a (13.0 ha.)	69.3
Multiple Family Housing - No. of Units: 0	0.0	0.0
Local Commercial	2.7 a (1.13 ha.)	5.8
Parks and Walkways	3.2 a (1.33 ha.)	6.9
Roads - 20 m R/W Length: 970 m (4.7 a/1.90 ha.) - 15 m R/W Length: 1050 m (3.6 a/1.45 ha.)		
Total Roads	8.3 a (3.4 ha.)	18.0

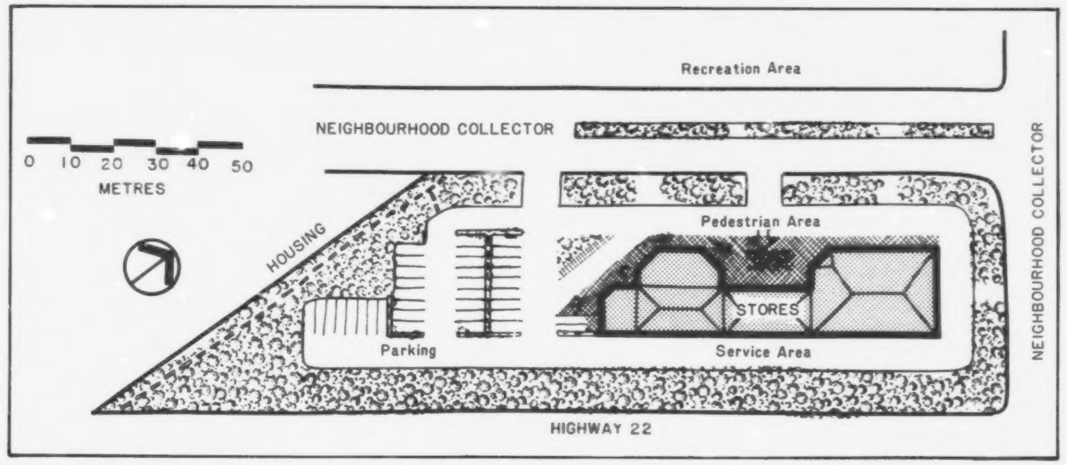
Area 1 is the most westerly residential area and consists of 74 single family lots adjacent to the existing Bragg Creek hamlet. Entry to the area is via a single access point along the eastern boundary. The road system comprises a number of minor cul-de-sacs off the central internal neighbourhood collector road. Because the most westerly site entry to the community is gained along the eastern boundary of this area, the collector through this area itself forms a cul-de-sac. Therefore, the road system should contribute to minimal through traffic resulting in a most secluded atmosphere. Map 3.2 outlines the land use plan for Area 1.

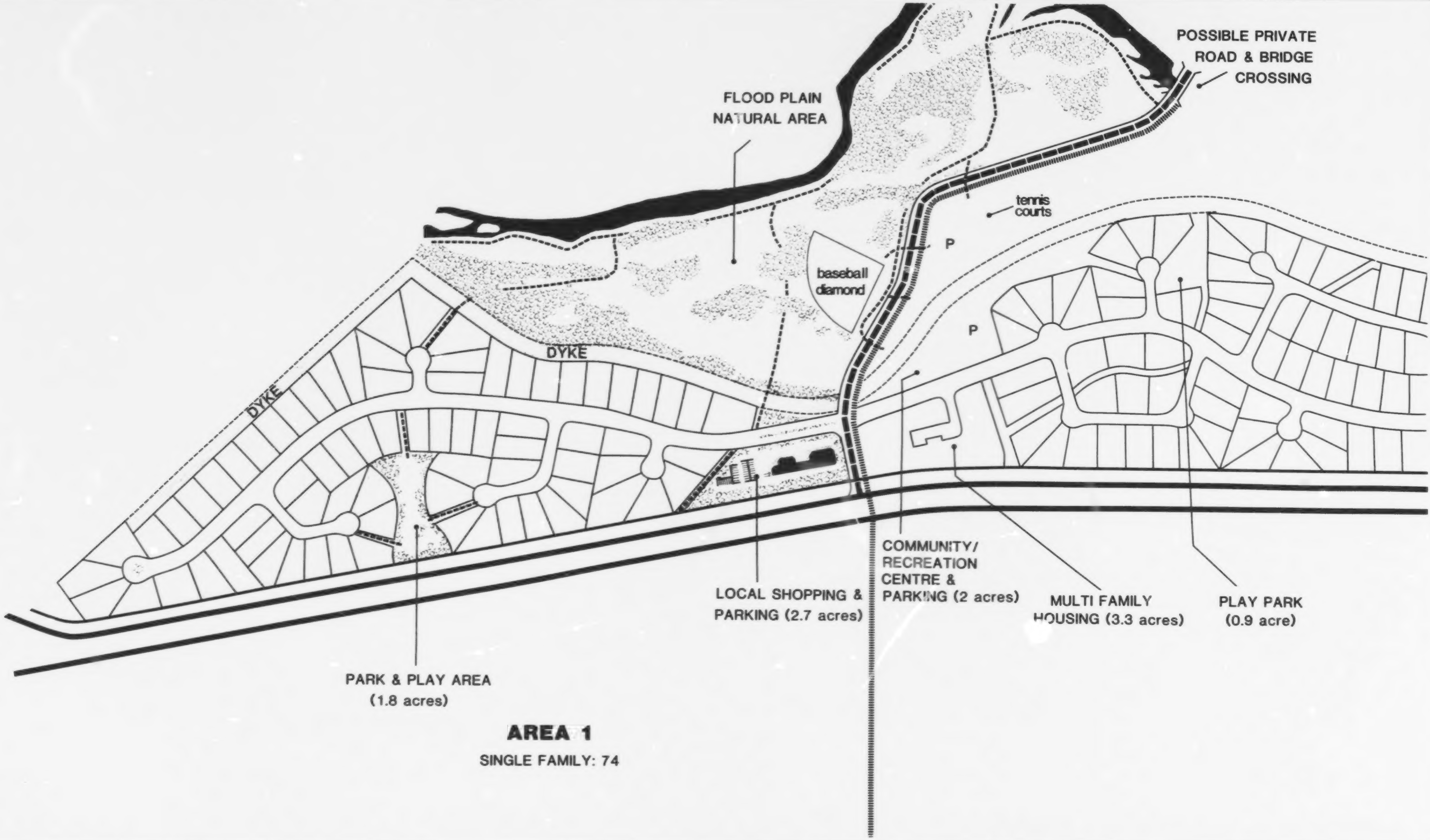
Central to this area is a 1.8 acre (0.72 ha.) local park to which access can be gained via a number of walkways which also can be used as emergency vehicular access routes. Almost 50% of the land included in Area 1 is located in the flood plain which, with the exception of a possible softball diamond and tennis courts, will be left undisturbed for passive recreation pursuits. The location of the flood plain and general shape of the area further emphasize the seclusion of the housing.

At the junction of the collectors providing entry to Area 1 and access to Highway 22 is a 2.7 acre (1.1 ha.) local commercial facility. It is primarily intended to provide convenience shopping facilities (eg. milk, eggs, etc.) complementing those provided in the larger community/neighbourhood centre located in Area 5. However, the site is sufficiently large to accommodate expansion should demand require further facilities in the area. The possibility of locating a restaurant facility catering to a regional population, in the same fashion as the golf course, might be feasible. This site is large enough and well located in relation to the highway and golf course to capitalize on the possible demand without any loss of seclusion for the housing in the area. Exhibit 3.1 outlines a concept for this commercial facility.

EXHIBIT 3.1

LOCAL COMMERCIAL FACILITY
(AREA 2) CONCEPT




FLOOD PLAIN NATURAL AREA
POSSIBLE PRIVATE ROAD & BRIDGE CROSSING
tennis courts
P
baseball diamond
P
DYKE
DYKE
LOCAL SHOPPING & PARKING (2.7 acres)
COMMUNITY/ RECREATION CENTRE & PARKING (2 acres)
MULTI FAMILY HOUSING (3.3 acres)
PLAY PARK (0.9 acre)
PARK & PLAY AREA (1.8 acres)
AREA 1
SINGLE FAMILY: 74

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AREA 1 LAND USE PLAN

3.2.2 Area 2

TABLE 3.7

AREA 2
LAND USE SUMMARY

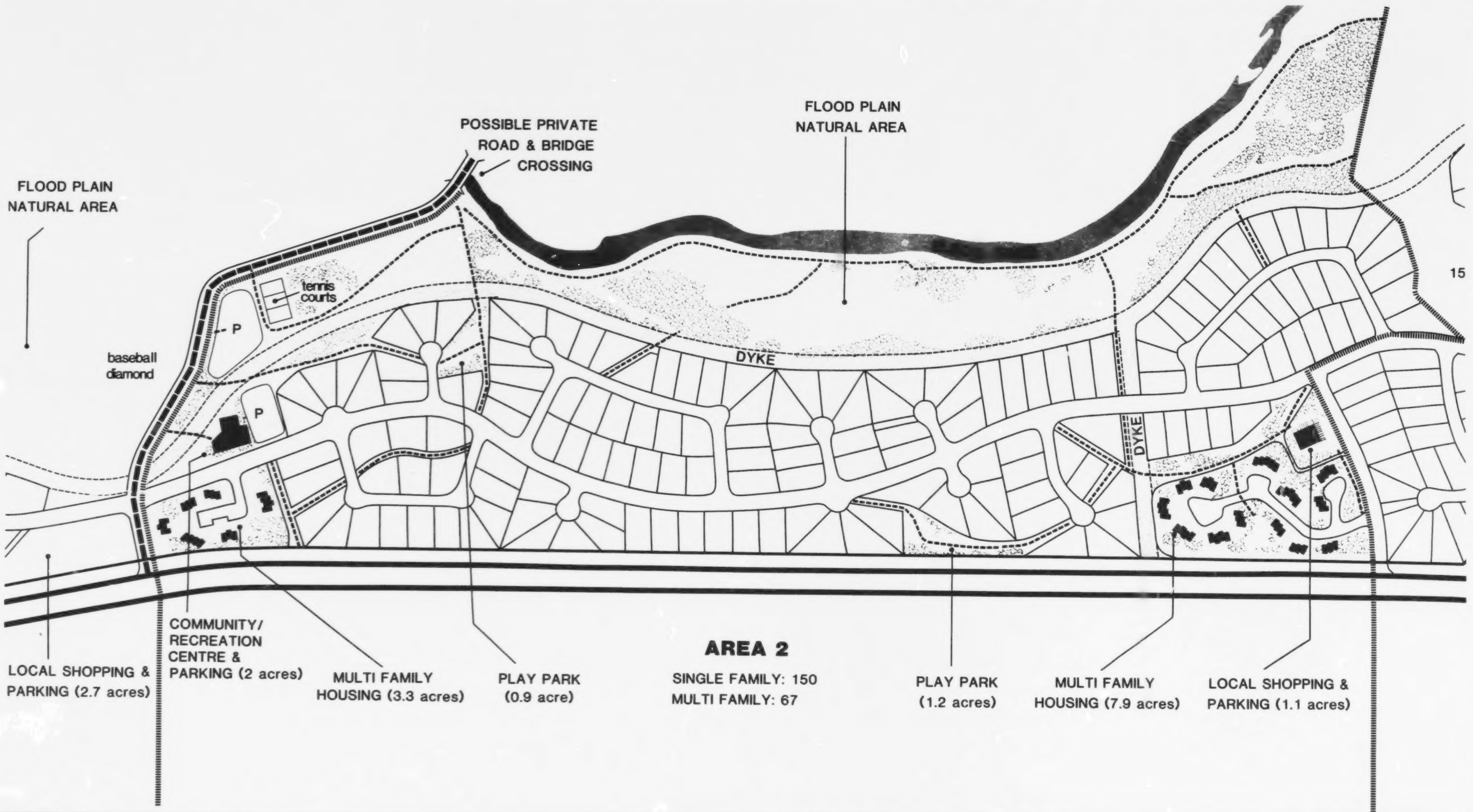
	Area	Percentage of Net Developable Area
Total Area	155.6 a (63.0 ha.)	-
Net Developable Area	97.3 a (39.4 ha.)	100.0
Single Family Housing - No. of Lots: 150	64.7 a (26.2 ha.)	66.5
Multiple Family Housing - No. of Units: 67	11.2 a (4.5 ha.)	11.5
Local Commercial	1.1 a (0.5 ha.)	1.1
Parks and Walkways	5.0 a (2.0 ha.)	5.1
Community Centre	2.0 a (0.8 ha.)	2.1
Roads - 20 m R/W Length: 1500 m (7.4a/3.0 ha.) - 15 m R/W Length: 1600 m (5.9a/2.4 ha.)		
Total Roads	13.3 a (5.4 ha.)	13.7

Area 2 consists of 97.3 acres (39.4 ha) of developable land between two of the access points to Highway 22. As shown on Map 3.3, single family housing totals 150 lots, located on a series of crescents and cul-de-sacs off the central neighbourhood internal collector road. Two multiple family medium density housing sites are proposed at either end of the area, both are south and east of the collector road. In these locations good access to the highway and community facilities is afforded while minimizing through traffic within the area. The two sites provide for approximately 20 and 47 units respectively. In keeping with the design objectives for Redwood Meadows, all the multiple family sites have been designed to incorporate clustered development utilizing both central parking areas and private driveway access.

Two small mini-parks are provided for childrens play, one on either side of the collector road. A concept for development of these types of facilities is shown on Exhibit 3.2. Again, as is the case with all the recreation areas, they are linked to the housing areas by a series of walkways which form an almost continuous pedestrian system throughout the Redwood Meadows Community. Only infrequently will a resident have to walk (or ride) beside the roads, and then only for short stretches.

One of the two major recreation community centres serving the total development is located in the south-west part of Area 2. Adjacent to the dyke a two acre site (0.8 ha) is proposed for a community/recreation centre. This facility could provide for squash, racquetball, badminton, etc. Some of these facilities - the tennis courts are located in the flood plain on the other side of the dyke. The softball diamond located in Area 1 also forms an integral part of this facility.

Convenience shopping needs are also catered to in 1.1 acre (0.4 ha) local shopping area located in the extreme east of Area 2. Similar to the facility in Area 1, this centre will complement the shopping provided in Area 5. Due to its size and other sites the number of shops in this area will be kept to a minimum.


FLOOD PLAIN NATURAL AREA
POSSIBLE PRIVATE ROAD & BRIDGE CROSSING
FLOOD PLAIN NATURAL AREA
15
tennis courts
P
baseball diamond
P
DYKE
DYKE
LOCAL SHOPPING & PARKING (2.7 acres)
COMMUNITY/ RECREATION CENTRE & PARKING (2 acres)
MULTI FAMILY HOUSING (3.3 acres)
PLAY PARK (0.9 acre)
AREA 2
SINGLE FAMILY: 150
MULTI FAMILY: 67
PLAY PARK (1.2 acres)
MULTI FAMILY HOUSING (7.9 acres)
LOCAL SHOPPING & PARKING (1.1 acres)

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AREA 2 LAND USE PLAN

3.2.3 Area 3

TABLE 3.8

AREA 3
LAND USE SUMMARY

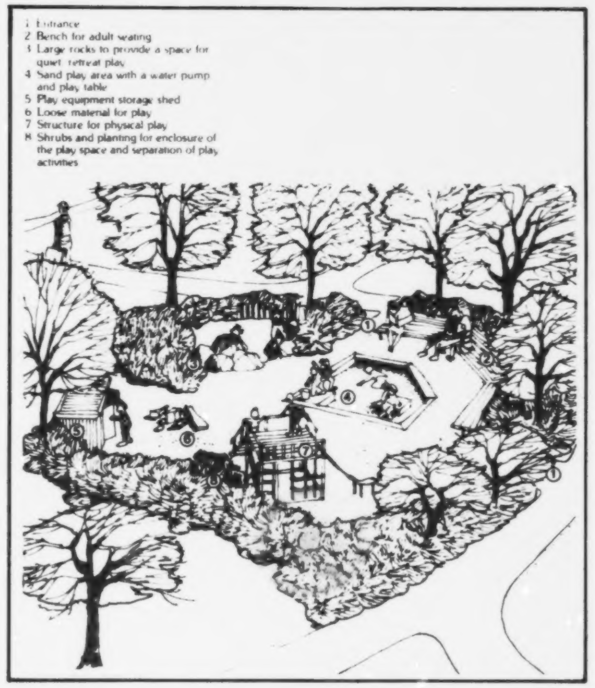
	Area	Percentage of Net Developable Area
Total Area	*247.5 a (100.2 ha.)*	-
Net Developable Area	*111.7 a (45.2 ha.)*	*100.0*
Single Family Housing *- No. of Lots: 168*	*88.0 a (35.6 ha.)*	*78.8*
Multiple Family Housing *- No. of Units: 0*	*0.0*	*0.0*
Local Commercial	*0.0*	*0.0*
Parks and Walkways	*3.9 a (1.6 ha.)*	*3.5*
Roads *- 20m R/W Length: 1880 m (9.3a/3.8 ha.)* *- 15m R/W Length: 2360 m (9.4a/3.8 ha.)*		
Parking Area Extension: (1.1a/0.4 ha.)		
Total Roads	*19.8 a (8.0 ha.)*	*17.7*

The major feature and attraction of Area 3 is Redwood Meadows golf course. In order to take full advantage of this feature the area has been designed exclusively for single family housing. One hundred and sixty eight lots on 88.0 acres have been designed in a series of clusters and crescents between holes ten to eighteen of the golf course. About one-half back directly onto one of the nine fairways.

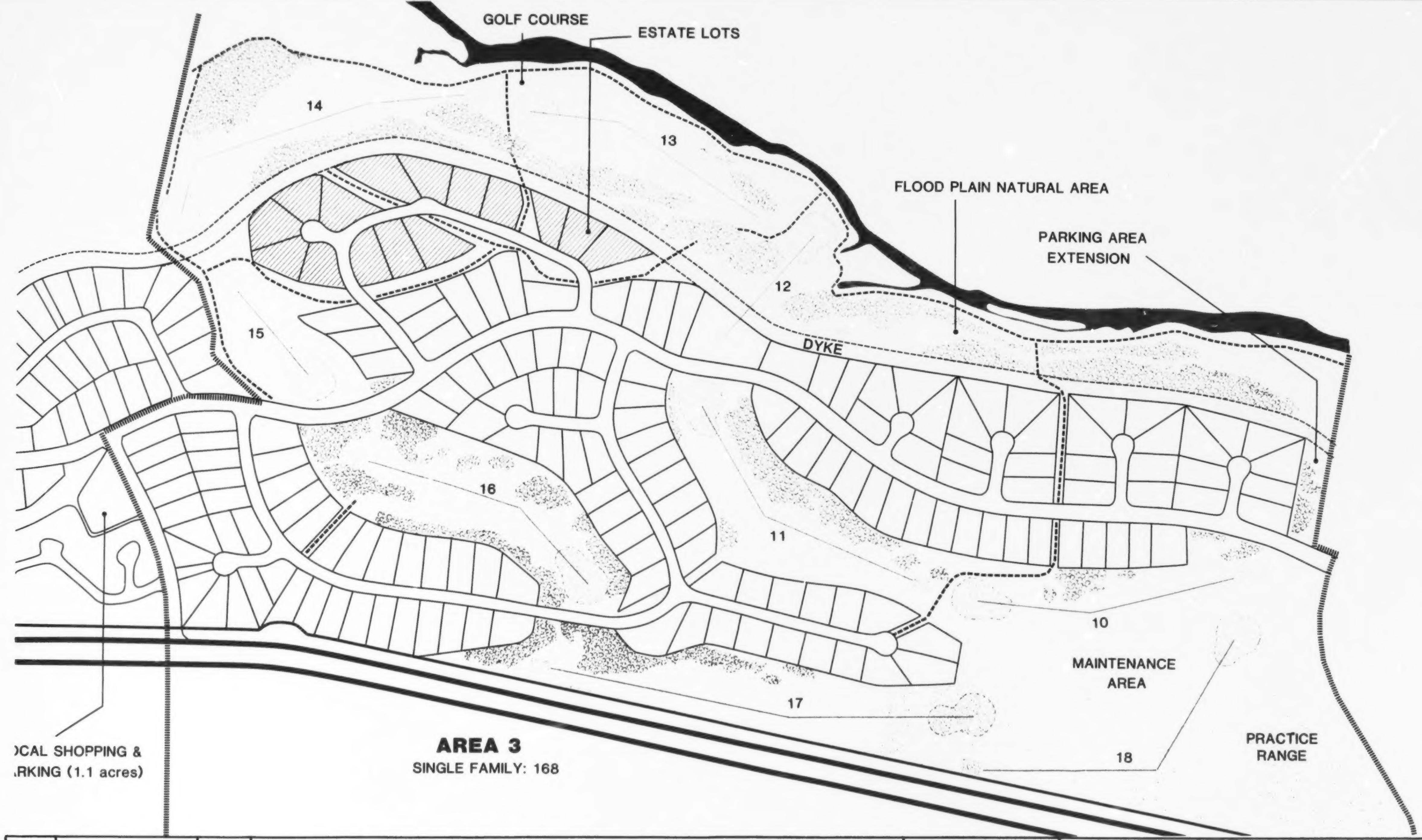
A highlight of Area 3 is the presence of 15 "estate" lots backing onto holes thirteen, fourteen, or fifteen of the golf course or a number of small creeks running through the area. These lots range in size from 0.5 a (2,000 m^2) to almost 0.7 a (2,800 m^2) above the normal size of between 0.3 a (1,200 m^2) and 0.5 a (2,000 m^2). The size and secluded location of these lots will make this area a most desirable place to live. Map 3.4 identifies the land-use plan for Area 3.

EXHIBIT 3.2

CHILDREN'S PLAY PARK CONCEPT


1 Entrance
2 Bench for adult seating
3 Large rocks to provide a space for quiet retreat play
4 Sand play area with a water pump and play table
5 Play equipment storage shed
6 Loose material for play
7 Structure for physical play
8 Shrubs and planting for enclosure of the play space and separation of play activities

Source: Central Mortgage and Housing Corporation. Play Spaces for Pre-Schoolers. N.H.A. 5138 3/78. C.M.H.C., Ottawa, 1978. Page 35.


GOLF COURSE
ESTATE LOTS
14
13
FLOOD PLAIN NATURAL AREA
PARKING AREA
EXTENSION
12
15
DYKE
16
11
10
MAINTENANCE
AREA
17
18
PRACTICE
RANGE
ɔCAL SHOPPING &
ıRKING (1.1 acres)
AREA 3
SINGLE FAMILY: 168

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AREA 3 LAND USE PLAN

3.2.4 Area 4

TABLE 3.9

AREA 4
LAND USE SUMMARY

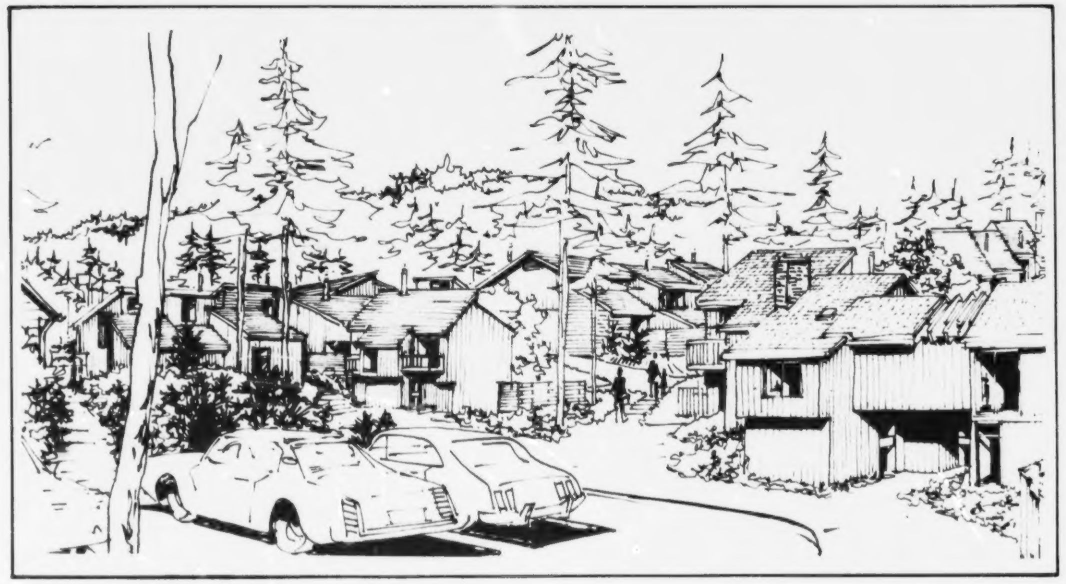
	Area	Percentage of Net Developable Area
Total Area	229.7 a (93.0 ha.)	-
Net Developable Area	112.9 a (45.7 ha.)	100.0
Single Family Housing - No. of Lots: 189	77.9 a (31.6 ha.)	69.0
Multiple Family Housing - No. of Units: 38	6.4 a (2.6 ha.)	5.7
Local Commercial	0.0	0.0
Parks and Walkways	5.1 a (2.1 ha.)	4.5
Roads - 20 m R/W Length: 4200 m (20.9 a/8.45 ha.) - 15 m R/W Length: 700 m (2.6 a/11.1 ha.)		
Total Roads	23.5a (9.5 ha.)	20.8

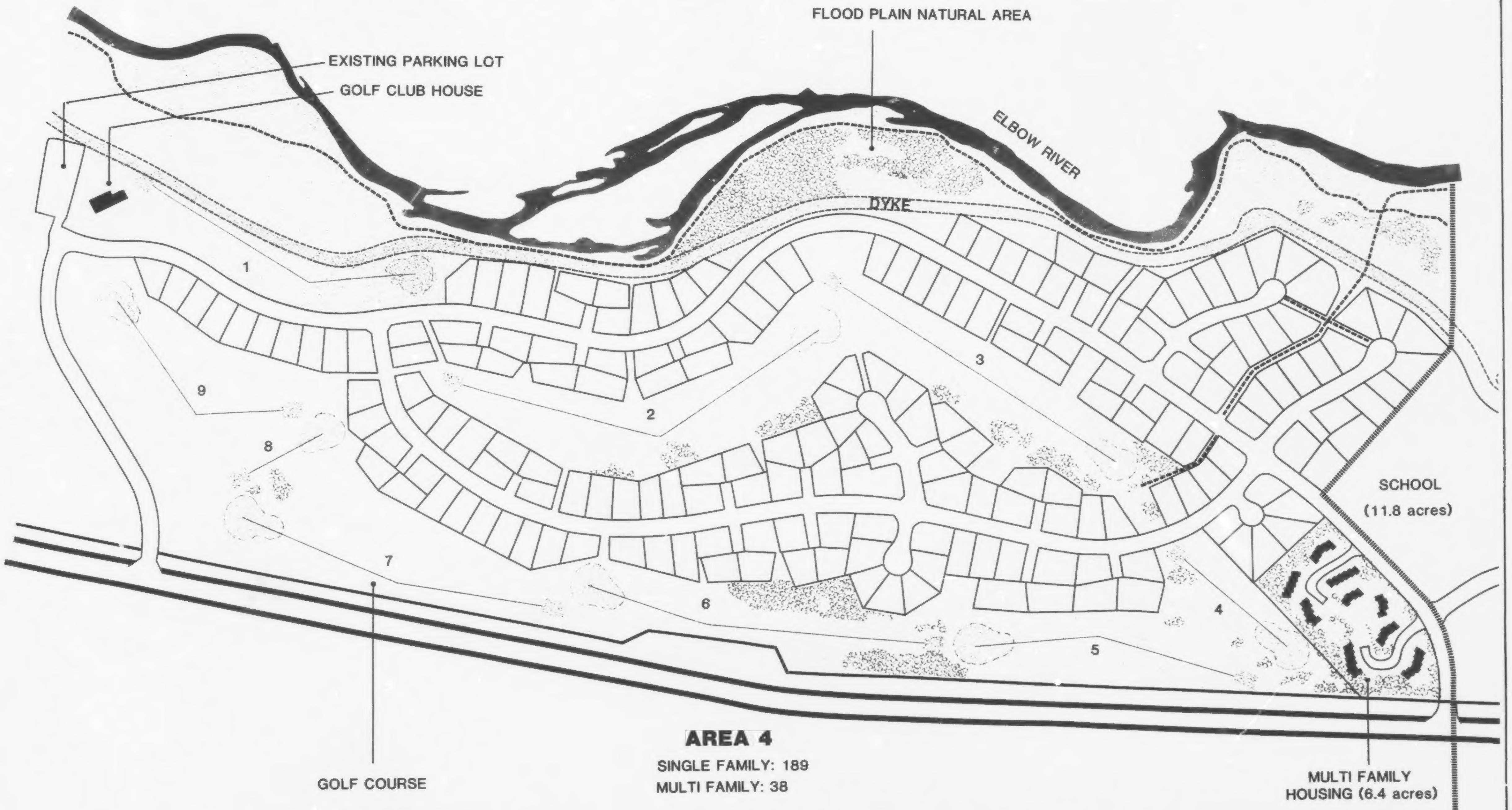
Area 4 represents the current Phase 1 development. Designed around holes one to nine of the golf course with the clubhouse located in the west, this area has been slightly expanded in scope to provide 189 single family lots and a 6.4 acre (2.6 ha.) multiple family site. This site is located on the neighbourhood collector road and across from the proposed school and commercial facilities in Area 5. This site will accommodate approximately 38 units. An impression of housing for the area is shown on Exhibit 3.3.

The design for Phase 1 is similar to that for later phases and reflects design objectives and principles which emphasize use of clustered housing in cul-de-sacs and along crescent roads.

EXHIBIT 3.3

MULTIPLE-FAMILY HOUSING (AREA 4) CONCEPT




FLOOD PLAIN NATURAL AREA
EXISTING PARKING LOT
GOLF CLUB HOUSE
ELBOW RIVER
DYKE
1
2
3
4
5
6
7
8
9
SCHOOL
(11.8 acres)
GOLF COURSE
MULTI FAMILY
HOUSING (6.4 acres)

AREA 4

SINGLE FAMILY: 189
MULTI FAMILY: 38

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AREA 4 LAND USE PLAN

3.2.5 Area 5

TABLE 3.10

AREA 5
LAND USE SUMMARY

	Area	Percentage of Net Developable Area
Total Area	199.1 a (80.6 ha.)	-
Net Developable Area	98.8 a (40.0 ha.)	100.0
Single Family Housing - No. of Lots: 162	61.2 a (24.8 ha.)	61.9
Multiple Family Housing - No. of Units: 0	0.0	0.0
Community Commercial Centre	6.0 a (2.4 ha.)	6.1
Parks and Walkways	4.2 a (1.7 ha.)	4.3
School Site	11.8 a (4.87 ha.)	11.9
Roads - 20 m R/W Length: 1700 m (8.4 a/3.4 ha.) - 15 m R/W Length: 1700 m (7.2 a/2.92 ha.)		
Total Roads	15.6a (6.3 ha.)	15.8

Area 5 provides 162 single family housing lots on 61.2 acres (24.8 ha) of land. No multiple family housing sites are identified for this area. Map 3.6 outlines the land use plan for Area 5.

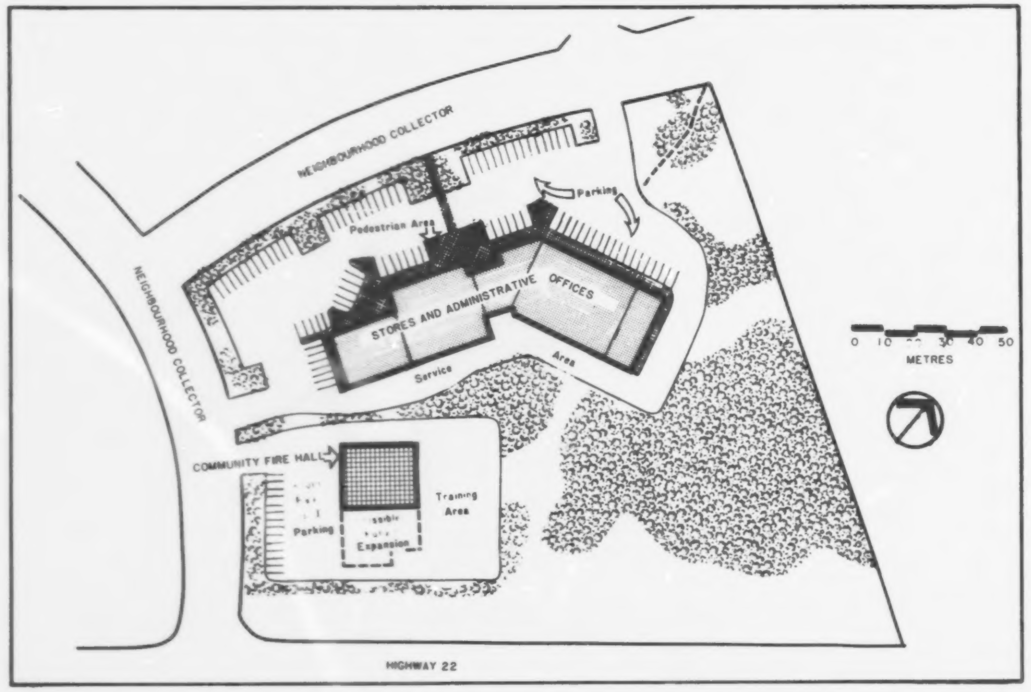
A one acre (0.4 ha) local play park has been set aside for children's play activities.

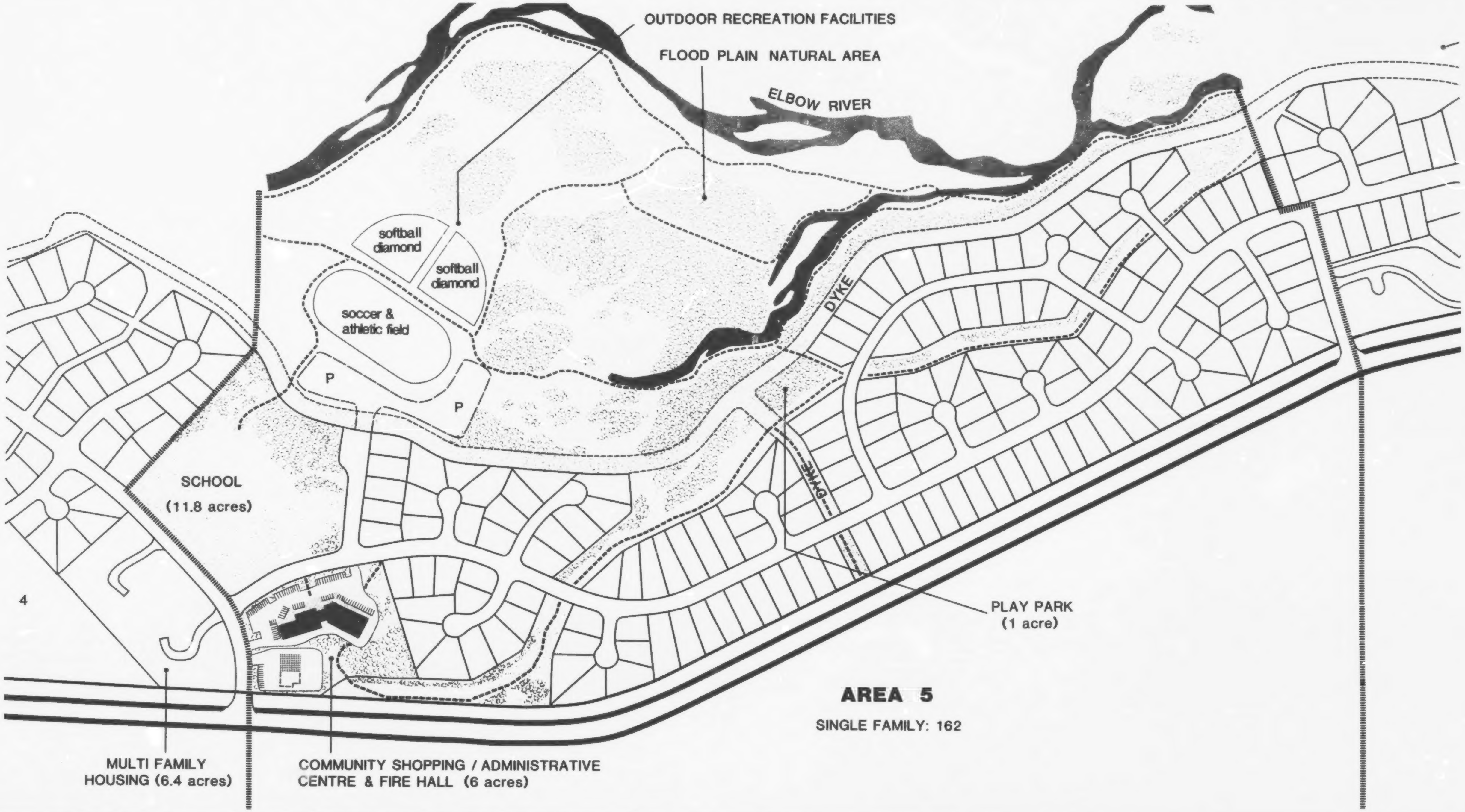
Provision of the school facilities to serve the Redwood Meadows development has been made in Area 5 in the form of an 11.8 acre (4.8 ha.) site. As previously stated, more than one school facility could be located on this site. School playing fields are proposed on the north side of the dyke adjacent to the site. Sufficient land has been identified to accommodate several baseball diamonds, a football field, and additional school parking.

Across the collector road from the school site is located the 6.0 acre (2.4 ha.) community shopping centre site. This site is intended to accommodate the majority of local shopping facilities serving Redwood Meadows as well as administrative functions and provision of protective services such as the fire hall. A concept for this facility is shown on Exhibit 3.4.

EXHIBIT 3.4

COMMUNITY SHOPPING AND ADMINISTRATION CENTRE CONCEPT


NEIGHBOURHOOD COLLECTOR
NEIGHBOURHOOD COLLECTOR
Parking
Pedestrian Area
STORES AND ADMINISTRATIVE OFFICES
Service
Area
COMMUNITY FIRE HALL
Training Area
Parking
Expansion
HIGHWAY 22
0 10 20 30 40 50
METRES


OUTDOOR RECREATION FACILITIES
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
softball diamond
softball diamond
soccer & athletic field
P
P
DYKE
DYKE
SCHOOL
(11.8 acres)
4
PLAY PARK
(1 acre)
AREA 5
SINGLE FAMILY: 162
MULTI FAMILY HOUSING (6.4 acres)
COMMUNITY SHOPPING / ADMINISTRATIVE CENTRE & FIRE HALL (6 acres)

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AREA 5 LAND USE PLAN

3.2.6 Area 6

TABLE 3.11

AREA 6
LAND USE SUMMARY

	Area	Percentage of Net Developable Area
Total Area	119.5 a (48.4 ha.)	-
Net Developable Area	92.9 a (37.6 ha.)	100.0
Single Family Housing - No. of Lots: 133	51.4 a (20.78 ha.)	55.3
Multiple Family Housing - No. of Units: 74	12.4 a (5.0 ha.)	13.3
Local Commercial	0.0	0.0
Parks and Walkways	6.5 a (2.6 ha.)	7.1
Recreation Centre	12.0 a (4.9 ha.)	12.9
Roads - 20 m R/W Length: 1000 m (4.9 a/1.98 ha.) - 15 m R/W Length: 1460 m (5.7 a/2.32 ha.)		
Total Roads	10.6 a (4.3 ha.)	11.4

Area 6 completes the Redwood Meadows Community Plan. As shown on Map 3.7, it is located at the eastern extremity of the area and the concept proposed envisages 133 single family lots, a multiple family site for 74 units, a 3.7 acre (1.5 ha.) neighbourhood play park, and, in the far eastern corner, a site for an arena and outdoor recreational facilities.

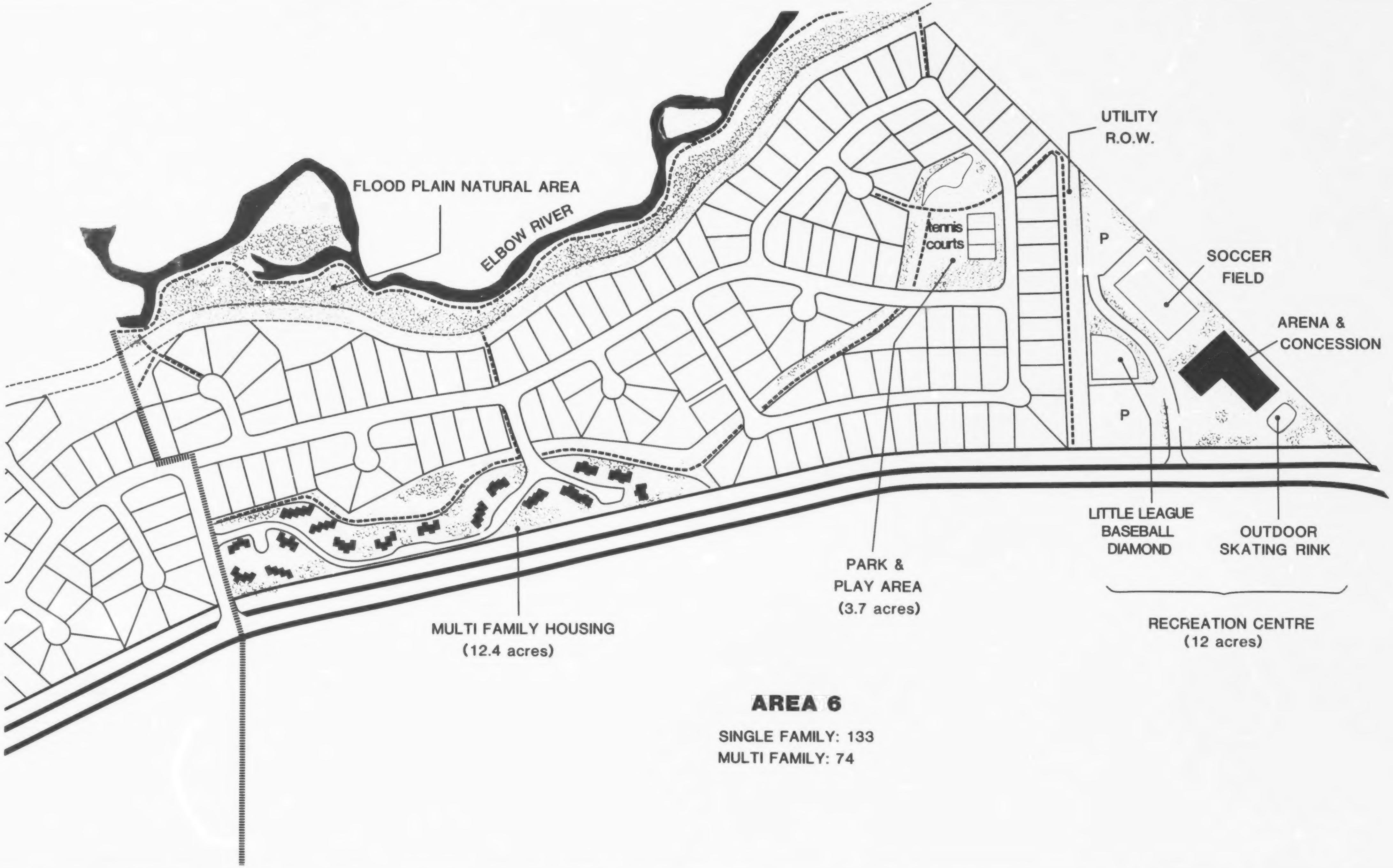
The single family lots are again arranged in a number of cul-de-sacs and crescents located off the central neighbourhood collector road. As in the case of Area 1, the collector effectively forms a cul-de-sac system, the only exit to the rest of Redwood Meadows and Highway 22 being at the western boundary of the area. This arrangement enhances the seculsion and attractiveness of the area for housing. This situation is further reinforced in the site chosen for the recreation centre.

Access to the recreation centre is achieved via a separate road from Highway 22. There is no direct road connection to the facility via the internal collector, virtually eliminating the intrusion of through traffic. The 12.0 acre (4.9 ha.) site could accommodate both indoor recreation facilities such as an arena and skating rinks as well as playing fields for football and baseball etc.

Table 3.12 provides a general guide to the space requirements for popular recreational activities, which could be located on this site and others in the community.

The 12.4 acre (5.0 ha.) multiple family development in Area 6 features housing adjacent to a creek and pathway running through the site. The creek area can be developed as a small park. The site also backs onto the single family lots and as a result is removed from the collector road, further enhancing its exclusive and secluded situation.

In conclusion, the preceeding discussion on the main design aspects of the six areas reveals the development of a residential community which offers diversity of choice in housing style and location; set in a very desirable rural setting but also within easy reach of the range of community, shopping, and recreational facilities demanded by residents. These facilities further enhance the uniqueness of the development in offering a comprehensive range of urban services but within a rural environment.


UTILITY
R.O.W.
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
tennis
courts
P
SOCCER
FIELD
ARENA &
CONCESSION
P
LITTLE LEAGUE
BASEBALL
DIAMOND
OUTDOOR
SKATING RINK
PARK &
PLAY AREA
(3.7 acres)
RECREATION CENTRE
(12 acres)
MULTI FAMILY HOUSING
(12.4 acres)
AREA 6
SINGLE FAMILY: 133
MULTI FAMILY: 74

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AREA 6 LAND USE PLAN

TABLE 3.12

DESIGN GUIDELINES
SELECTED RECREATION FACILITIES

		Total Area		
Activity	*Play Area (Feet)*	*Dimensions*	*Square Feet*	*Number of Players*
Archery	*Length; 90 - 300*	*50 (minimum) x 450 (maximum)*		
Badminton	*Single; 17 x 44* *Double; 20 x 44*	*25 x 60* *30 x 60*	*1,500* *1,800*	*2* *4*
Baseball	*Diamond; 90 x 90*	*300 x 300 (minimum)* *350 x 350 (average)*	*90,000* *122,500*	*18*
Basketball (men)	*Minimum; 42 x 74* *Maximum; 50 x 94*	*60 x 100 (average)*	*6,000*	*10*
Basketball (women)	*45 x 90*	*55 x 100 (average)*	*5,500*	*12-18*
Bowling (lawn)	*One alley; 14 x 100*	*120 x 120 (eight alleys)*	*14,400*	*32-64*
Box Lacrosse	*Minimum; 60 x 160* *Maximum; 90 x 200*	*85 x 185 (average)*	*15,725*	*14*
Curling	*Between hacks; 138*	*14 x 150*	*2,100*	*8*
Field Hockey	*Minimum; 150 x 270* *Maximum; 180 x 300*	*200 x 350 (average)*	*70,000*	*22*
Football	*195 x 300; plus end zones*	*195 x 480*	*93,600*	*24*
Handball	*20 x 34*	*30 x 45*	*1,350*	*2 or 4*
Horseshoes (men)	*Between stakes; 40*	*12 x 50*	*600*	*2 or 4*
Horseshoes (women)	*Between stakes; 30*	*12 x 40*	*480*	*2 or 4*
Ice Hockey	*Minimum; 65 x 165* *Maximum; 85 x 200*	*85 x 185 (average)*	*15,725*	*12*
Lacrosse	*Minimum; 210 x 450*	*260 x 500 (average)*	*130,000*	*24*
Soccer (men)	*Minimum; 150 x 300* *Maximum; 300 x 390*	*240 x 360 (average)*	*86,400*	*22*
Soccer (women)	*Minimum; 120 x 240* *Maximum; 180 x 300*	*200 x 320*	*64,000*	*22*
Softball	*Diamond; 60 x 60*	*250 x 250 (minimum)*	*62,500*	*20*
Speedball (men)	*Minimum; 160 x 240* *Maximum; 160 x 360*	*180 x 300* *180 x 420*	*54,000* *75,600*	*22*
Table Tennis	*5 x 9*	*12 x 20*	*240*	*2 or 4*
Tennis	*Single; 27 x 78* *Double; 36 x 78*	*50 x 120* *60 x 120*	*6,000* *7,200*	*2* *2 or 4*
Touch Football	*160 x 300*	*175 x 330*	*57,750*	*22*
Volleyball	*30 x 60*	*50 x 80*	*4,000*	*12-16*

4 SERVICING

4.0 SERVICING

4.1 GENERAL

Present development in Redwood Meadows is serviced by underground utilities which include gravity sewers, a pressurized water distribution system, gas, electrical and telephone services. Surface runoff is collected by ditches adjacent to all roads and directed to natural drainage channels discharging into the Elbow River.

All proposed developments in the Redwood Meadows subdivision should be serviced with complete underground utilities to provide similar development standards to that found in Phase I.

Where possible, sizing of these services are based on the City of Calgary Design Guidelines for Subdivisions. The design parameters and criteria used for services are outlined in this report.

The report Redwood Meadows Geotechnical Investigation, May 1980, by Klohn Leonoff Consultants Ltd., made recommendations regarding the design and installation of buildings, roadways and services. Due to the high water table and the granular native material, utility installation problems will be encountered making installation of these services both difficult and costly.

4.2 DESIGN PARAMETERS AND CRITERIA

4.2.1 Population Projection

Based on the proposed layouts as shown in Section 3.0 of this plan, population estimates can be made for the various development areas. The total population for the complete development of the Redwood Meadows community will be limited to the number of lots available. For design purposes the total population based on 1055 residential dwellings would be 4041 people.

4.2.2 Water Demands

Residential water use rates are continually fluctuating. Redwood Meadows will likely experience the usual upward trend in per capita consumption common to other communities. For review and future design purposes a projected per capita consumption of 545 P/c/d[1] (120 igcd)[2] should be used. The peak daily water consumption is estimated to be 2.0 times the average daily consumption and the peak hourly consumption is estimated to be 3.5 times the average hourly consumption.

In smaller communities, fire flows are a major factor in sizing feed and distribution mains. The recommended fire flows may be greater than the peak hour demands in many of the areas. The fire flow rates outlined on Table 4.1 are recommended by the Insurance Advisory Organization (I.A.O.). The IAO procedure for required fire flow is based upon the type of construction and building floor area.

TABLE 4.1

FIRE FLOW RATES

Residential	
- widely scattered dwellings, detached about 30 m - minimum 30 l/s (400 igpm) to 45 l/s (600 igpm) plus 30 l/s (400 igpm) for cedar shingles.	- 60 - 75 l/s (800-1000 gpm)
- Modern Town or Row Houses 2½ stories	- 90 l/s (1200 gpm)
Institutional	
- schools	- 90 l/s (1200 gpm)
Commercial	
- small open shopping centre with sprinkler system. (40,000 ft^2) 3700 m^2	-115 l/s (1500 gpm)

A water supply system is considered to be adequate for fire protection when it can supply water as specified above for a minimum 2 hour duration with consumption at the maximum daily rate.

---

[1] Litres per capita per day.

[2] Imperial gallons per capita per day.

4.2.3 Sanitary Sewage Flows

Sanitary sewage flows for the development area will fluctuate similar to those varying demands for water consumption. For design purposes, the peak sewage flows are based on the City of Calgary design guidelines:

$$\text{Peak flow (lcd)} = 1120 + \frac{400}{P} \quad (\text{IF } P < 0.65, \text{ Peak Flow - } 1735 \text{ lcd})$$

where P is the population in thousands.

The above formula allows for a normal infiltration rate of 55 l/mm/km/day (500 Igpd/inch/mile). Above normal infiltration, as found in the existing development Area 4, must be added to these flows.

4.3 Water Distribution System

4.3.1 Existing Facilities

Water supply for the Redwood Meadows Subdivision is obtained from the Elbow River. The water flows by gravity through a 350 mm diameter intake line into a 1800 mm diameter wet well. Low level pumps lift the water into the treatment facilities where the water is treated and clarified. After clarification, the water is chlorinated and enters the transfer tank. From this transfer tank the water goes into an existing 1600 cu metre (350,000 Ig) reservoir and into the distribution system. Pressure in the distribution system is maintained by two 10 hp vertical turbine service pumps. The existing distribution system is shown on Map 4.1. A schematic diagram showing both the existing and proposed distribution system is shown on Exhibit 4.1.

4.3.2 Assessment of Existing System

At present the existing distribution system is capable of supplying sufficient water to meet the daily demands as well as provide a minimum reserve storage of 900 m^3 for fire demands for the existing development.

The low level pumps (lifting water from the wet well to the treatment facility) have a combined design capacity of approximately 26 l/s (340 Igpm). The theoretical maximum discharge from these pumps is slightly less than the present capacity of the existing clarifier/filter treatment facility, which is approximately 27 l/s (350 Igpm). Actual capacities of these pumps should be determined by field testing.

Capacity of the existing system is presently limited by the discharge capacity of the two existing service pumps. Discharge from these two pumps is approximately 17 l/s (225 gpm). This flow would meet the peak hour demand for approximately 770 people.

Adequate storage capacity is available to meet the fire demand storage requirements plus have an emergency reserve storage of 700 m^3. Fire flow rates are, however, restricted by the limited capacity service pumps. Plans are presently being completed to install an additional fire flow pump in early 1981, which will provide the necessary fire flow requirements.

The existing distribution system piping is of Asbestos Cement pipe ranging in sizes from 150 mm diameter to 300 mm diameter. Pressure in the existing system is maintained by the two 10 hp vertical turbine service pumps located in the pumphouse. Watermains in the existing system have the capacity to meet fire flow requirements of the Insurers Advisory Organization of Canada.

4.3.3 Waterworks for Future Developments

It appears that a possible and logical way to develop the remaining areas of land would be in the following order:

1. Area 4 - infilling (existing development - Phase I);
2. Area 5 - under construction;
3. Area 6 - north-east area of property;
4. Area 3 - development south-east of the present development, within the existing golf course;
5. Area 2 - south-west of Area 3; and
6. Area 1 - south-west of Area 2.

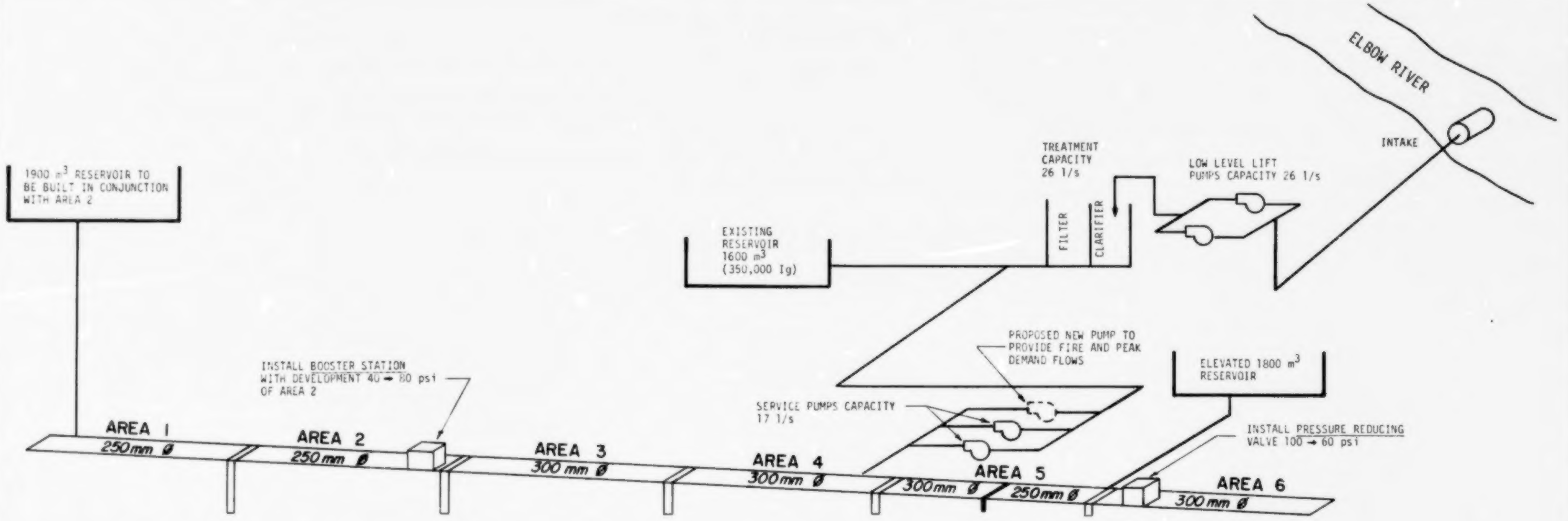
For purposes of this plan, servicing of these areas will be discussed in this order. The actual development sequence may, however, differ.

Based on a review and assessment of the existing water supply and distribution system and using the design parameters as outlined in this report, the following expansions and upgrading of the system for future development will be required. Tables 4.2 and 4.3 indicate daily demands and storage requirements respectively.

The existing treatment facilities are capable of treating water at a rate of approximately 27 l/s. This volume of treatment would just meet the average daily demands of a projected population of 4041 people. Storage requirements, therefore, should have emergency storage capacities as well

EXHIBIT 4.1

WATER DISTRIBUTION SYSTEM SCHEMATIC


ELBOW RIVER
INTAKE
TREATMENT CAPACITY 26 l/s
LOW LEVEL LIFT PUMPS CAPACITY 26 l/s
FILTER
CLARIFIER
EXISTING RESERVOIR 1600 m^3 (350,000 Ig)
1900 m^3 RESERVOIR TO BE BUILT IN CONJUNCTION WITH AREA 2
PROPOSED NEW PUMP TO PROVIDE FIRE AND PEAK DEMAND FLOWS
ELEVATED 1800 m^3 RESERVOIR
INSTALL BOOSTER STATION WITH DEVELOPMENT 40 → 80 psi OF AREA 2
SERVICE PUMPS CAPACITY 17 l/s
INSTALL PRESSURE REDUCING VALVE 100 → 60 psi
AREA 1
250mm Ø
AREA 2
250mm Ø
AREA 3
300 mm Ø
AREA 4
300mm Ø
AREA 5
300mm Ø
250mm Ø
AREA 6
300 mm Ø

- CUMMULATIVE PEAK FLOW FOR COMPLETE DEVELOPMENT = 89 l/s
- TOTAL STORAGE REQUIRED = 5300 m^3
- FIRE AND EQUALIZATION STORAGE = 2400 m^3
- FIRE + MAX. DAY STORAGE = 5300 m^3 = TOTAL

- CUMMULATIVE PEAK HR. = 83 l/s
- TOTAL STORAGE AVAILABLE
  - EXISTING + N.E. RESERVOIR = 3400 m^3
- STORAGE REQUIRED FOR FIRE + EQUALIZATION = 2200 m^3
- FIRE + MAX. DAY = 4980 m^3
- WITH N.E. AND EXISTING RESERVOIR HAVE 2500 m^3 FOR EQUALIZATION AND EMERGENCY USE = 1.2 AVERAGE DAY DEMAND (6 MAX. DAY DEMAND)
- SHOULD INSTALL 1900 m^3 RESERVOIR WITH DEVELOPMENT OF AREA 2

- CUMMULATIVE PEAK HR. = 65 l/s
- STORAGE AVAILABLE N.E. + EXISTING RESERVOIR = 3400 m^3
- STORAGE REQUIRED FOR:
  - FIRE + EQUALIZATION 192 m^3
  - FIRE + MAX. DAY 4100 m^3
  - STILL HAVE 1.5 AVERAGE DAY STORAGE

(EXISTING DEVELOPMENT)

- PEAK HR. = 19 l/s
- FIRE DEMAND = 90 l/s + 11 l/s = 101 l/s
  101 l/s 17 l/s
  INSTALL FIRE PUMP IMMEDIATELY
- STORAGE AVAILABLE 1600 m^3
- FIRE + EQUALIZATION 927 m^3
- FIRE + MAX. DAY = 1850 m^3

(UNDER CONSTRUCTION)

- CUMMULATIVE PEAK HR. = 33 l/s
- FIRE = 90 + 19 = 109 l/s
  109 l/s 101 l/s OK
- STORAGE = 1600 m^3
- FIRE + EQUALIZATION = 1170 m^3
- FIRE + MAX. DAY = 2560 m^3
- HAVE .42 MAX. DAY + FIRE

- CUMMULATIVE PEAK HR. = 50 l/s
- STORAGE = 1600 + 1800 = 3400 m^3
- FIRE + EQUALIZATION = 1675
- FIRE + MAX. DAY = 3380
- INSTALL 1800 m^3 RESERVOIR WITH AREA 6 DEVELOPMENT

- STORAGE REQUIREMENTS
  - EQUALIZATION - INTAKE IS LIMITED SOME NEED STORAGE TO MEET PEAK DEMANDS
  - FIRE - SHOULD HAVE RESERVE STORAGE OF 900 m^3 AT ALL TIMES (2 HRS. AT APPROX. 125 l/s)
  - EMERGENCY - TO PROVIDE WATER DURING DISRUPTION OF THE SYSTEM, I.E. PUMP REPAIRS, TREATMENT REPAIRS, LINE REPAIRS

- FIRE FLOW = MAX. DAY + FIRE
- MAX. DAY = TWO X AVERAGE DAY
- PEAK DAY = 3.5 X AVERAGE FLOW BASED ON AVERAGE DAY

RESERVOIRS SPACED ON EITHER END OF THE SYSTEM WILL PROVIDE WATER SUPPLY ON BOTH ENDS OF A SINGLE LINE, EFFECTIVELY "LOOPING" THE SYSTEM.

as capacity for fire fighting needs. Emergency volume will provide water when the intake or treatment facilities are disrupted. Map 4.1 shows the proposed system improvements required for future developments.

a) Area 4

As indicated on Table 4.2, the peak hour demand, based on average daily demands, for Area 4, all lots occupied, is approximately 19 l/s (250 Igm). This demand is approximately equal to the capacity of the two service pumps.

With all lots occupied, the combined fire flow and maximum daily rate for this area should be 101 l/s (1333 Igpm). The present service pumps are inadequate to meet these demands. Installation of an additional pump to meet these fire demands is presently under consideration. Space for this pump is available in the pumphouse.

The present 350,000 Ig reservoir has adequate storage capacity to meet fire storage requirements, as well as having 900 m^3 availabe for emergency (1.45 days of average daily demand) and equalization demands.

b) Area 5

Area 5 peak hour demands combined with Area 4 peak hour demands will result in a cumulative demand of 34 l/s (450 Igpm). With installation of an additional pump as discussed in Area 4, both the peak demands and fire flow requirements can be met.

With development of Area 5, the effectiveness of the present 1600 m^3 (350,000 Ig) reservoir for emergency use will be reduced. Reserving 900 m^3 (200,000 Ig) for fire fighting use, the remaining 700 m^3 (750,000 Ig) will supply approximately 0.82 days of average daily demand (0.41 days of maximum day demand). Emergency storage equal to two days of average daily demand would be desirable.

If operation pressure at the pumphouse is maintained at 80 psi, pressures in Area 5 will range from approximately 85 to 100 psi. A pressure reducing valve should be installed at the north-east end of this area, prior to development of Area 6, to reduce operating pressures in Area 6.

c) Area 6

Combining fire storage requirements of 900 m^3 (200,000 Ig) plus two days storage for areas 4, 5 and 6 would result in total storage requirements of

TABLE 4.2

DAILY WATER DEMANDS

Development Area	Population	Total Avg. Daily Demand m^3	Max. Day Avg. Day m^3	Peak Hour Based on Avg. Day L/s	Cummulative Peak Hour Demand L/s	Cummulative Avg. Daily Demand L/s	Cummulative Max. Day Demand L/s
4	870	475	950	19	19	5.5	11
5	648	350	700	14	33	9.5	19
6	754	410	820	17	50	14.5	29
3	672	365	730	15	65	18.5	37
2	801	440	880	18	83	24.	47
1	296	160	320	6	89	25.	51
TOTAL	4041	2200 (485000 Ig)	4400 (970000 Ig)	-	89	25	51

Note: 1 L/s = 13.2 Igpm
$1 m^3 = 220$ Ig

TABLE 4.3

WATER STORAGE REQUIREMENTS

Development Area	Population	Fire Storage m^3	Equalization Storage Cummulative[1] m^3	Fire Plus Equalization m^3	Cummulative Avg. Daily Demand m^3	Two x Cummulative Average Plus Fire (= Peak Day plus fire) m^3
4	870	900	27	927	475	1850
5	648	900	270	1170	830	2560
6	754	900	775	1675	1240	3380
3	672	900	1025	1925	1600	4100
2	801	900	1320	2220	2040	4980
1	296	900	1500	2400	2200	5300
TOTAL	4041	5400	1500	2400	2200	5300

[1] Equalization storage is based on Maximum Day with maximum treatment capacity of 26.5 L/s (350 Igpm).

$1m^3 = 220$ Ig.

approximately 3,400 m^3 (750, 000 Ig). With the existing reservoir having a capacity of 1600 m^3, additional storage of approximately 1800 m^3 would be desirable. This storage would provide emergency water for these areas. Because the subdivision is very narrow, looping of distribution lines becomes very costly. An elevated reservoir, either on site or on higher land south-east of the development would also ensure that water for daily demands and fire fighting needs would be available during water line repairs in these areas.

A pressure reducing valve south-east of Area 6 would reduce pressures within this area. Pressures over 100 psi are not desirable for domestic use.

d) Area 3

Total peak hour flows for Areas 3 to 6 inclusive will be 65 l/s (860 igpm). Installation of the additional pump, combined with the existing and proposed north-east reservoir, will meet the combined fire flows and average daily demand requirements.

Pressures in Area 3 will range from approximately 45 to 65 psi when pressure at the pumphouse is maintained at 80 psi.

e) Area 2

A booster station will be required prior to construction in this area. The station should be located, as shown on Map 4.1, between Areas 2 and 3. The station will increase pressure from approximately 45 psi to 80 psi.

Total storage requirements, fire and maximum day storage, for Areas 2 to 6 inclusive will equal 5000 m^3 (1,100,000 Ig). Construction of a 1900 m^3 (420,000 Ig) elevated reservoir located south-east of Area 1, as shown on Map 4.1, combined with the existing and proposed north-east reservoir will provide the total fire and daily demand storage requirements for the total projected population of 4041 people. This reservoir will also provide emergency supply during line and supply repairs.

f) Area 1

The 1900 m^3 south-east reservoir has the capacity to meet all storage requirements for this area. Pressures in the area will range from 40 to 60 psi after being boosted to 80 psi between Areas 2 and 3.

4.3.4 Alternative Development Sequence

An alternative to developing in the order as outlined in Section 4.3.3. would be the development of Area 3 prior to Area 6. If development follows this alternate sequence, the following water system improvements will still be required prior to development of this area:

a) Immediate installation of a fire pump in the existing pumpstation; and
b) Installation of the north-east reservoir.

Construction of the south-east reservoir should proceed with development of Area 2, even if Area 2 preceeds the development of Area 6.

4.3.5 Summary of Proposed Water System Improvements

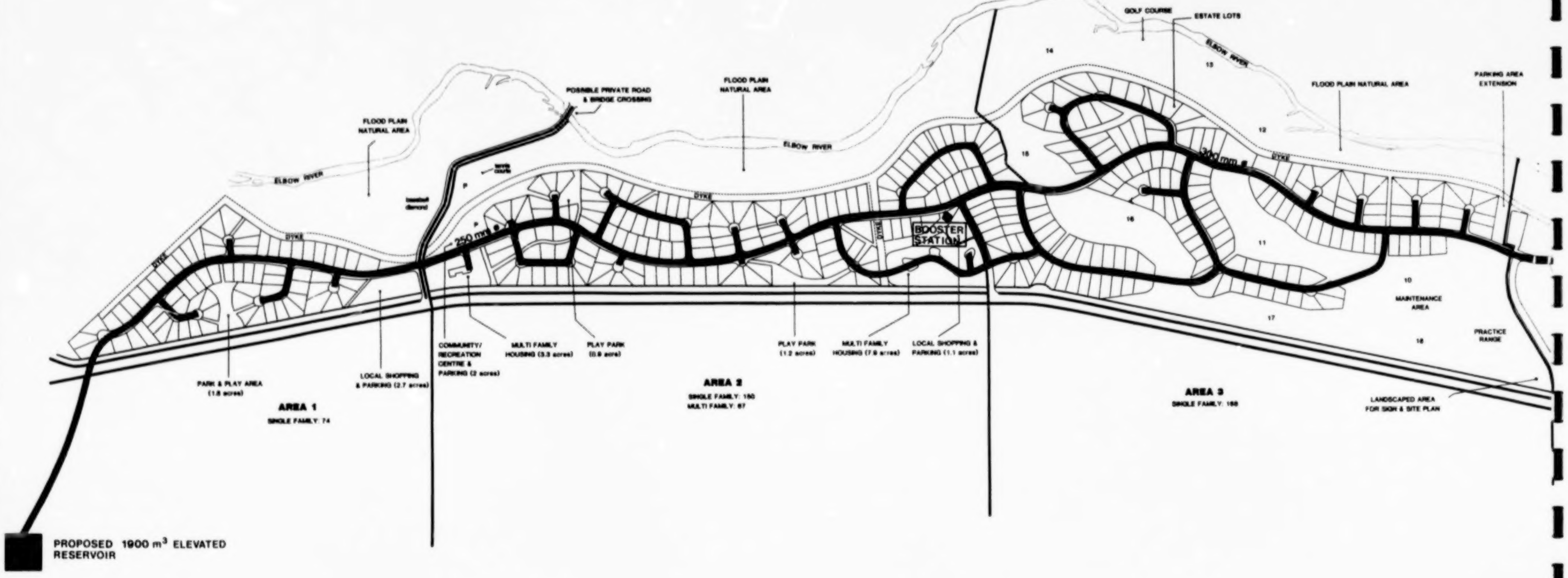
In order to provide an adequate distribution system for the complete development of Redwood Meadows to meet both domestic water requirements as well as fire flow requirements, the following additions and improvements to the system should be made:

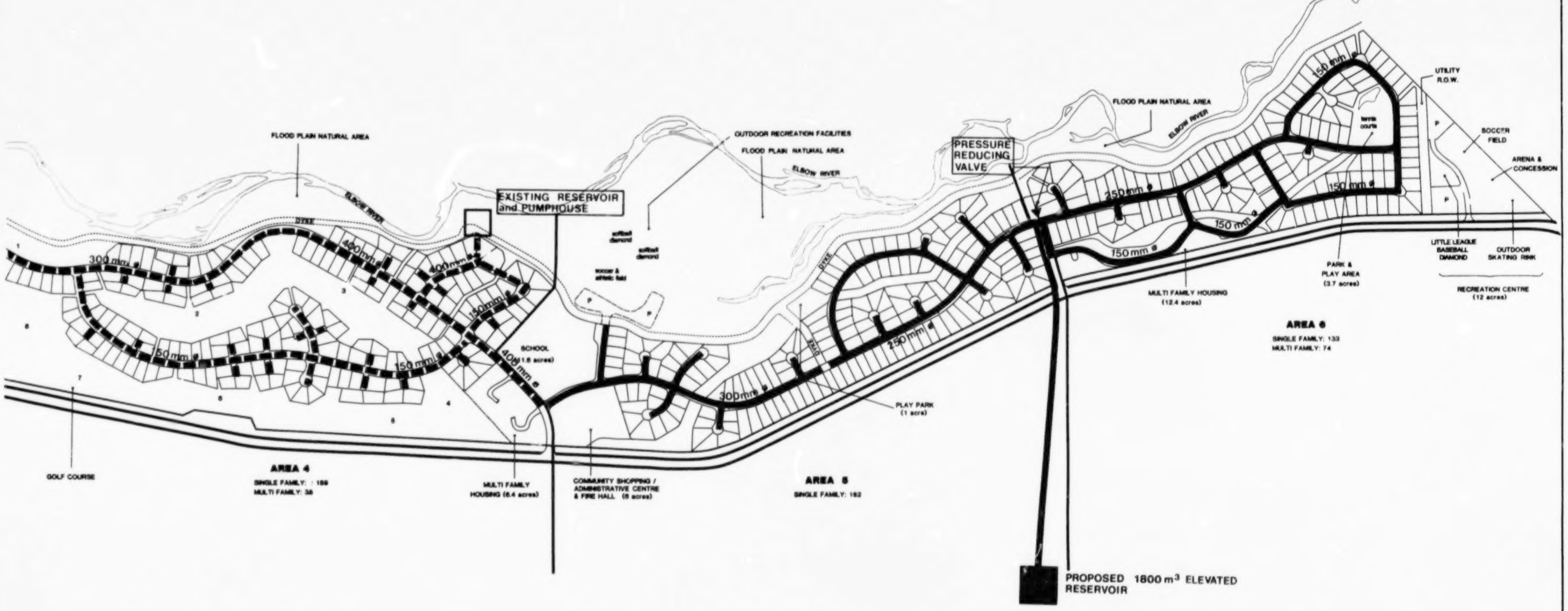
a) Immediate installation of a fire pump in the existing pumphouse;
b) The capacity of the existing low level pumps as well as the service pumps should be checked;
c) An elevated north-east reservoir to provide additional storage to meet emergency and fire fighting demands should be installed prior to development of Area 6, or any other area preceeding the development of Area 5;
d) Installation of a pressure reducing valve prior to development of Area 6;
e) Install a booster station prior to development of Area 2; and
f) Install elevated south-east reservoir prior to development of Area 2 to meet emergency and fire fighting demands.

4.4 SANITARY SEWER SYSTEM

4.4.1 Existing Facilities

As shown on Map 4.2, the Phase I development - Area 4 is serviced by a gravity sewage collection system. Sewage collected within this network of 300 mm diameter and 375 diameter clay tile and asbestos cement lines, flows by gravity to a sewage lift station located on the far north-east end of the property. From this point sewage is forced through a force main to the sewage lagoons located on Reserve property approximately 5 km east of the

POSSIBLE PRIVATE ROAD
& BRIDGE CROSSING
FLOOD PLAIN
NATURAL AREA
FLOOD PLAIN
NATURAL AREA
ELBOW RIVER
ELBOW RIVER
ELBOW RIVER
GOLF COURSE
ESTATE LOTS
FLOOD PLAIN NATURAL AREA
PARKING AREA
EXTENSION
tennis courts
baseball diamond
P
P
DYKE
DYKE
DYKE
DYKE
DYKE
250 mm ø
300 mm ø
BOOSTER
STATION
14
13
12
15
16
11
10
17
18
MAINTENANCE
AREA
PRACTICE
RANGE
PARK & PLAY AREA
(1.8 acres)
LOCAL SHOPPING
& PARKING (2.7 acres)
COMMUNITY/
RECREATION
CENTRE &
PARKING (2 acres)
MULTI FAMILY
HOUSING (3.3 acres)
PLAY PARK
(0.9 acre)
PLAY PARK
(1.2 acres)
MULTI FAMILY
HOUSING (7.9 acres)
LOCAL SHOPPING &
PARKING (1.1 acres)
LANDSCAPED AREA
FOR SIGN & SITE PLAN
AREA 1
SINGLE FAMILY: 74
AREA 2
SINGLE FAMILY: 150
MULTI FAMILY: 67
AREA 3
SINGLE FAMILY: 168
PROPOSED 1900 m³ ELEVATED
RESERVOIR


FLOOD PLAIN NATURAL AREA
ELBOW RIVER
DYKE
EXISTING RESERVOIR and PUMPHOUSE
300 mm ø
400 mm ø
400 mm ø
150 mm ø
150 mm ø
150 mm ø
400 mm ø
1
2
3
4
5
6
7
8
SCHOOL (1.6 acres)
GOLF COURSE
AREA 4
SINGLE FAMILY: 189
MULTI FAMILY: 38
MULTI FAMILY HOUSING (8.4 acres)
COMMUNITY SHOPPING / ADMINISTRATIVE CENTRE & FIRE HALL (6 acres)
OUTDOOR RECREATION FACILITIES
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
softball diamond
softball diamond
soccer & athletic field
P
P
DYKE
300mm ø
250mm ø
PLAY PARK (1 acre)
AREA 5
SINGLE FAMILY: 152
PRESSURE REDUCING VALVE
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
150 mm ø
250 mm ø
150 mm ø
150 mm ø
150 mm ø
tennis courts
UTILITY R.O.W.
P
P
SOCCER FIELD
ARENA & CONCESSION
LITTLE LEAGUE BASEBALL DIAMOND
OUTDOOR SKATING RINK
RECREATION CENTRE (12 acres)
PARK & PLAY AREA (3.7 acres)
MULTI FAMILY HOUSING (12.4 acres)
AREA 6
SINGLE FAMILY: 133
MULTI FAMILY: 74
PROPOSED 1800 m³ ELEVATED RESERVOIR

REDWOOD MEADOWS

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CONSULTING ENGINEERS AND PLANNERS

▬ PROPOSED MAINS
▬ ▬ ▬ EXISTING MAINS

4.1

0 50 100 250m

REDWOOD MEADOWS MASTER PLAN

WATER DISTRIBUTION SYSTEM

development. Present discharge from these lagoons is by evaporation and overflow into a ditch west of the lagoons.

4.4.2 Assessment of Existing Facilities

The present sewage collection system has serious infiltration problems. As documented in the report, Town of Redwood Meadows Sewer System Evaluation Survey, April 1980 by Mar-Tech Engineering Co. Ltd., the present measured infiltration at the lift station is approximately 755,000 litres/day (166,000 gpd). The allowable infiltration for this system was calculated as approximately 118,000 l/d (26,000 Igpd).

As recommended in the above report, the development company has proceeded with rehabilitation measures on the sewer system to reduce the infiltration by approximately 320,000 l/d (70,000 Igpd). An average infiltration rate of 320,000 l/d will still be realized after repairs have been made to the existing system. These flows must be accounted for in the review and design of the collection system, lift station, force main and sewage lagoons.

Assuming normal infiltration rates in the proposed development areas, the present outfall line has the capacity to handle the projected flows from all areas as well as the additional infiltration from Area 4. The outfall line, based on the minimum pipe capacity in this line, can handle flows up to 120 l/s. Projected peak flows for all developed areas is estimated to be 65 l/s.

The existing sewage treatment system is an aerated lagoon consisting of three main cells. The first cell is split into two equal compartments each with a 14,000 cubic metre capacity. One of these compartments is presently being used and comprises 33 subsurface aeration units. The other is intended to work in parallel for future flows. The second cell has a volume of approximately 62,000 cubic metres and has 21 subsurface aeration units. The third cell has a volume of 418,000 cubic metres and is not aerated. This last cell is to be used for storage during the winter months and will be drawn down during the summer season by evaporation and spray irrigation of the effluent.

The capacity of the lagoon system should be adequate to provide secondary treatment for the projected ultimate sanitary sewage flow, provided that excessive infiltration from Area 4 is reduced, as discussed previously, and that proposed development areas do not contribute more infiltration water than is allowed for in the design guidelines. Storage in the last cell will be enough for approximately 7½-8 months at ultimate flow, allowing approximately 4 months for spray irrigation.

A detailed study has been completed to determine how much water can safely be applied to the land, the best time of the year, and the most practical method of withdrawal and distribution and a sprinkler system has recently been installed to meet these requirements.

4.4.3 Sewage Collection for Future Developments

As shown on Map 4.2, virtually all proposed development areas can be serviced by gravity lines.

Collection of sewage from the 52 most northerly lots in Area 6 will have to be handled by gravity and lifted in to the trunk as shown on Figure 4.2. The trunk main at this point is not deep enough to collect these lots directly by gravity.

The sewage lift station at the extreme north-east end of the development has the capacity to handle a maximum peak flow of 34 l/s, with an additional standby capacity of 34 l/s. These pumps will be sufficient to handle flows from approximately 2000 people, or about one half of the development areas.

To meet the total projected peak flow of 65 l/s, the capacity of the existing lift station will need to be doubled.

4.4.4 Sanitary Sewer Summary

In addition to the installation of a pipe network of gravity sewers for the total development area, the following system improvements and additions will be required:

a) Infiltration in Area 4 must be reduced as recommended in the report Town of Redwood Meadows, Sewer System Evaluation Survey, April 1980, by Mar-Tech Engineering Co. Ltd.;
b) Infiltration in future developments be kept to an acceptable limit;
c) Increase the capacity of the lift station when the community's population reaches 2000 people; and
d) Install a separate small sewage lift station to service the 52 northerly lots in Area 6.

4.5 STORM COLLECTION

4.5.1 Surface Runoff, Existing and Proposed

All surface runoff in the present development and proposed development areas is collected by ditches adjacent to the roads. Water from these ditches is directed to natural drainage channels within the development areas. All existing drainage channels flow naturally to the Elbow River. Map 4.3 shows the proposed drainage system within the development areas.

Runoff from areas between transverse dykes are to be directed via ditches and natural drainage channels through flap gates installed in the main dyke upstream of the transverse dyke connection, as shown on Map 4.3. These gates will allow flows to pass through the gates in one direction only.

4.6 SHALLOW UTILITIES

4.6.1 Existing Shallow Utilities

At present, the Area 4 development is serviced by Alberta Government Telephones, Canadian Western Natural Gas, as well as Calgary Power. Cable Television services are not provided in this area.

4.6.2 Future Servicing

According to the respective shallow bury utility companies, sufficient capacity of their service is available for the complete Redwood Meadows development areas. Cable T.V. services installed will require front end costs by the developer, to be reimbursed when and if permission is granted to the Cable T.V. network to service the area.

4.7 ROADWAYS

4.7.1 Existing and Proposed Roads

Internal local roads with 15 metre rights-of-way feed traffic onto the 20 metre right-of-way internal collector roads. Because the subdivision is very long and narrow, one main community/neighbourhood collector road runs the entire length of the subdivision. This collector road feeds traffic onto Alberta Highway No. 22 which is a rural highway running adjacent to the entire development area. The collector road ties into the highway at five locations. The intersections are spaced equally at approximately 1200 metre intervals along the subdivision.

Since the highway is directly adjacent to the subdivision, most of the traffic leaving the subdivision will access to it via the nearest collector intersection. It may also be found that some of the traffic destined to more than one development area away may also use the highway as the preferred travelling route.

4.8 DYKES

4.8.1 General

As discussed previously, it has been recommended by PFRA that a dyke be constructed approximately 30 metres outside the 1923 year flood line (1:100 year flood). The top of dyke elevation should be equal to the 1 to 500 year flood, plus 750 mm, or the maximum probable flood level, whichever is greater.

According to PFRA's report, Elbow River Food Study, November 1975, the dyke is to be constructed from native flood plain deposits with borrow areas located along the River channel and in the River islands.

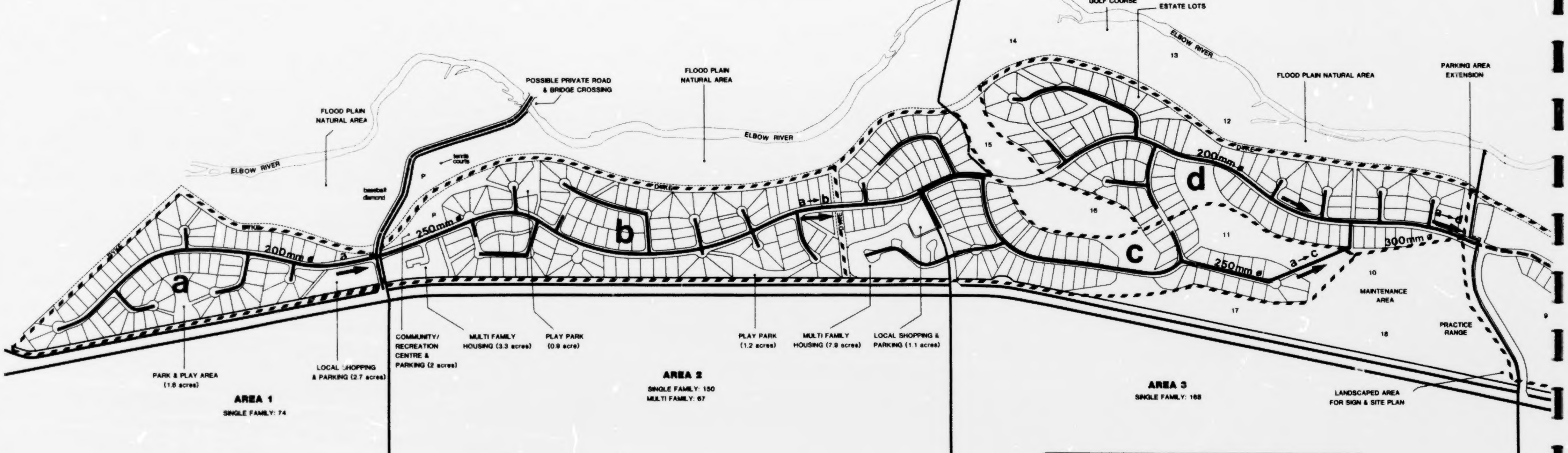
Construction of transverse dykes as shown on the master plan would limit flood damage, in the case of a local failure of the main dyke, to only that area between cross dykes and to provide assured access roads to the main dyke for maintenance purposes during times of high water.

4.8.2 Existing Dyke

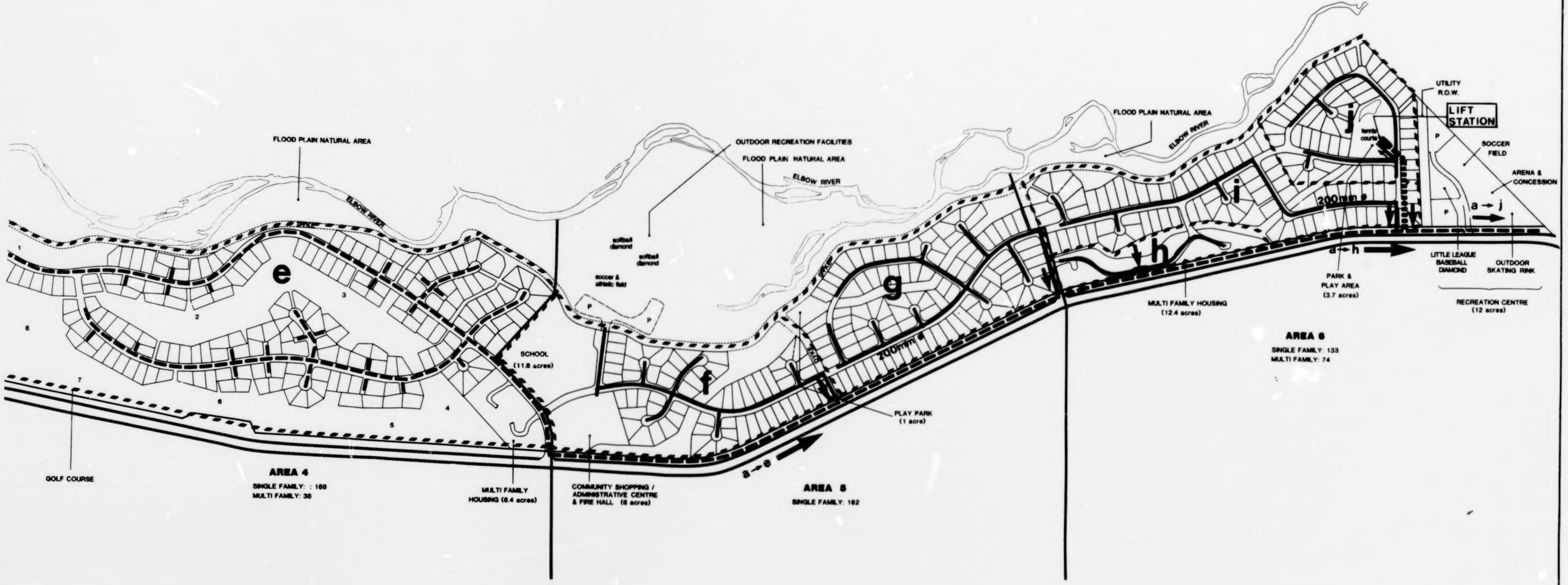
An existing dyke constructed of native flood plain deposit material extends along the entire length of the presently developed Area 4, located between the housing and the Elbow River.

As outlined in the report by Klohn Leonoff Consultants Ltd., Redwood Meadows Geotechnical Investigation, May 1980, a review of this existing dyke suggested that the facility was not built to the grades and alignment recommended by PFRA. The dyke crest may be 0.5 to 1.0 metres lower than that recommended. It is suggested that this difference may be enough to cause over topping during both a 1:500 year flood and the maximum probable flood. The report also suggests that the variations in alignment will result in flood levels different than those calculated by PFRA.

Klohn Leonoff Consultants Ltd. of Calgary are presently calculating new backwater curves based on the existing dyke alignment to determine at what elevations the existing dyke should be set. A report being prepared by Klohn Leonoff with this information should be available in early 1981.


ELBOW RIVER
FLOOD PLAIN NATURAL AREA
POSSIBLE PRIVATE ROAD & BRIDGE CROSSING
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
GOLF COURSE
ESTATE LOTS
ELBOW RIVER
FLOOD PLAIN NATURAL AREA
PARKING AREA EXTENSION
baseball diamond
tennis courts
P
DYKE
DIKE
200mm ø
250mm ø
300mm ø
a
b
c
d
a
a → b
a → c
a → d
9
10
11
12
13
14
15
16
17
18
PARK & PLAY AREA (1.8 acres)
LOCAL SHOPPING & PARKING (2.7 acres)
COMMUNITY/ RECREATION CENTRE & PARKING (2 acres)
MULTI FAMILY HOUSING (3.3 acres)
PLAY PARK (0.9 acre)
PLAY PARK (1.2 acres)
MULTI FAMILY HOUSING (7.9 acres)
LOCAL SHOPPING & PARKING (1.1 acres)
MAINTENANCE AREA
PRACTICE RANGE
LANDSCAPED AREA FOR SIGN & SITE PLAN
AREA 1
SINGLE FAMILY: 74
AREA 2
SINGLE FAMILY: 150
MULTI FAMILY: 67
AREA 3
SINGLE FAMILY: 168

CONTRIBUTING AREA	PEAK FLOW l/s
a	5.9
a → b incl.	15.1
a → c incl.	22.1
d	6.7
a → d incl.	27.6
a → e incl.	43.0
f	5.0
g	8.0
h	4.5
i	6.6
j	1.1
a → h incl.	54.0
a → j incl.	61.0
TOTAL PEAK FOR ALL AREAS	61.0


FLOOD PLAIN NATURAL AREA
ELBOW RIVER
OUTDOOR RECREATION FACILITIES
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
softball diamond
softball diamond
soccer & athletic field
P
P
e
f
g
h
i
j
1
2
3
4
5
6
7
8
SCHOOL
(11.8 acres)
GOLF COURSE
AREA 4
SINGLE FAMILY: : 180
MULTI FAMILY: 36
MULTI FAMILY
HOUSING (6.4 acres)
COMMUNITY SHOPPING /
ADMINISTRATIVE CENTRE
& FIRE HALL (6 acres)
a→e
AREA 5
SINGLE FAMILY: 162
PLAY PARK
(1 acre)
200mm ø
200mm ø
MULTI FAMILY HOUSING
(12.4 acres)
a→h
PARK &
PLAY AREA
(3.7 acres)
AREA 6
SINGLE FAMILY: 133
MULTI FAMILY: 74
tennis courts
UTILITY
R.O.W.
LIFT
STATION
P
P
SOCCER
FIELD
ARENA &
CONCESSION
a→j
LITTLE LEAGUE
BASEBALL
DIAMOND
OUTDOOR
SKATING RINK
RECREATION CENTRE
(12 acres)

REDWOOD MEADOWS

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CONSULTING ENGINEERS AND PLANNERS

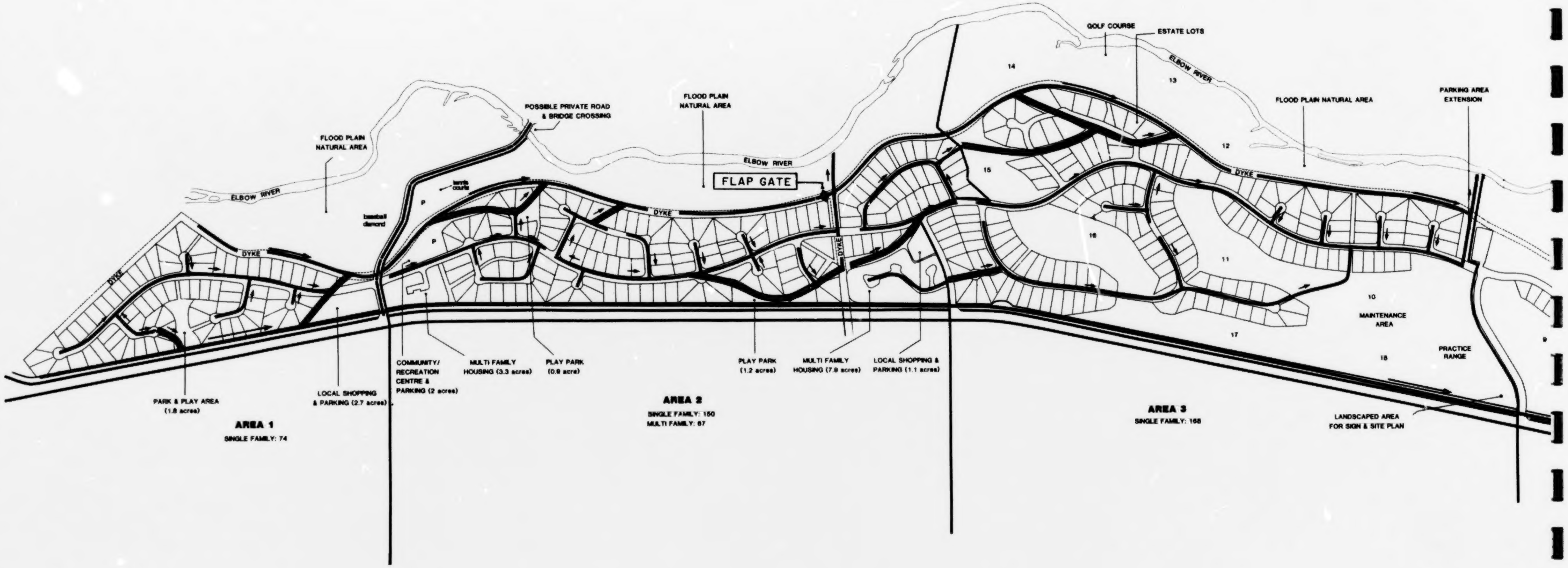
- - - - EXISTING LINES
▪▪▪▪▪▪ PROPOSED FORCE MAIN
—— PROPOSED SEWER LINES
- - - - COLLECTION AREAS

4.2

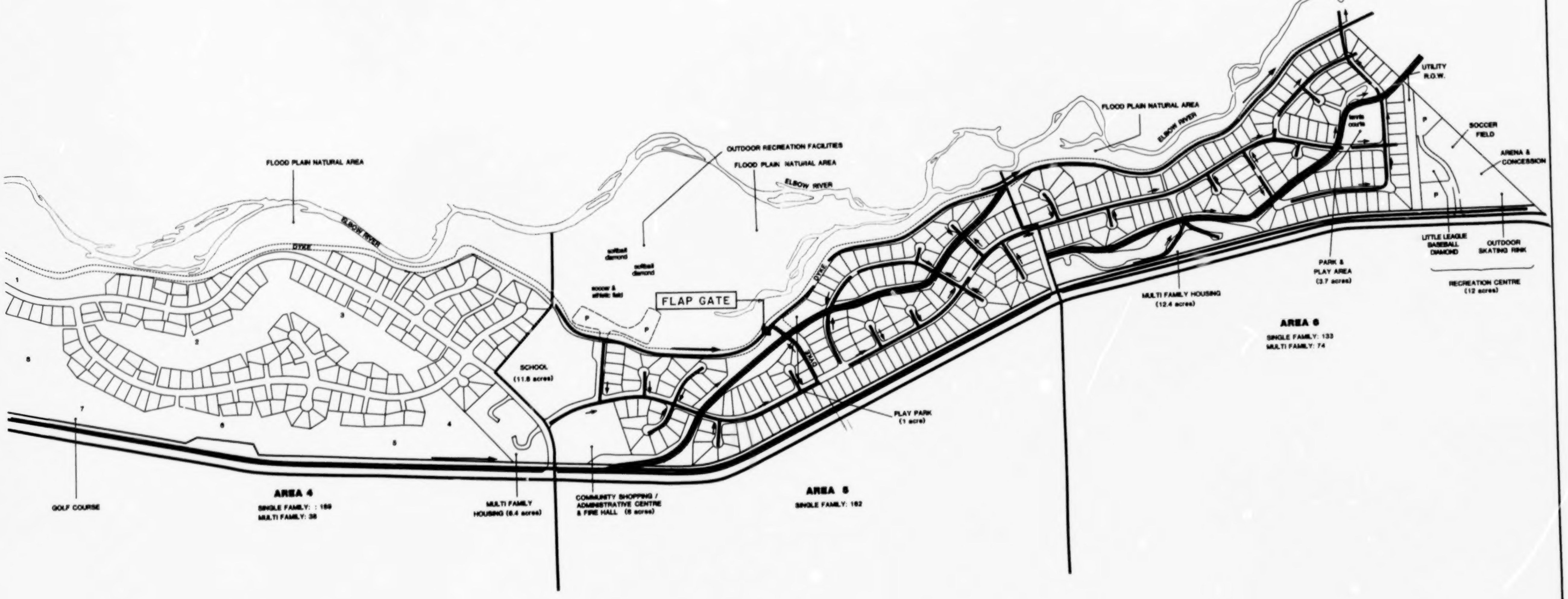
0 50 100 250m

REDWOOD MEADOWS MASTER PLAN

SANITARY SEWER SYSTEM



ELBOW RIVER
FLOOD PLAIN NATURAL AREA
DYKE
DYKE
baseball diamond
tennis courts
P
P
POSSIBLE PRIVATE ROAD & BRIDGE CROSSING
FLOOD PLAIN NATURAL AREA
DYKE
ELBOW RIVER
FLAP GATE
DYKE
GOLF COURSE
ESTATE LOTS
14
13
ELBOW RIVER
15
12
DYKE
16
11
FLOOD PLAIN NATURAL AREA
PARKING AREA EXTENSION
10
MAINTENANCE AREA
17
18
PRACTICE RANGE
9
PARK & PLAY AREA (1.8 acres)
LOCAL SHOPPING & PARKING (2.7 acres)
COMMUNITY/ RECREATION CENTRE & PARKING (2 acres)
MULTI FAMILY HOUSING (3.3 acres)
PLAY PARK (0.9 acre)
PLAY PARK (1.2 acres)
MULTI FAMILY HOUSING (7.9 acres)
LOCAL SHOPPING & PARKING (1.1 acres)
AREA 1
SINGLE FAMILY: 74
AREA 2
SINGLE FAMILY: 150
MULTI FAMILY: 67
AREA 3
SINGLE FAMILY: 168
LANDSCAPED AREA FOR SIGN & SITE PLAN


FLOOD PLAIN NATURAL AREA
ELBOW RIVER
DYKE
OUTDOOR RECREATION FACILITIES
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
softball diamond
softball diamond
soccer & athletic field
FLAP GATE
P
P
SCHOOL
(11.8 acres)
DYKE
DYKE
1
2
3
4
5
6
7
8
GOLF COURSE
AREA 4
SINGLE FAMILY: : 169
MULTI FAMILY: 38
MULTI FAMILY
HOUSING (6.4 acres)
COMMUNITY SHOPPING /
ADMINISTRATIVE CENTRE
& FIRE HALL (8 acres)
AREA 5
SINGLE FAMILY: 162
PLAY PARK
(1 acre)
FLOOD PLAIN NATURAL AREA
ELBOW RIVER
tennis courts
UTILITY
R.O.W.
SOCCER
FIELD
ARENA &
CONCESSION
P
P
MULTI FAMILY HOUSING
(12.4 acres)
PARK &
PLAY AREA
(3.7 acres)
LITTLE LEAGUE
BASEBALL
DIAMOND
OUTDOOR
SKATING RINK
RECREATION CENTRE
(12 acres)
AREA 6
SINGLE FAMILY: 133
MULTI FAMILY: 74

REDWOOD MEADOWS

DelCan DE LEUW CATHER CANADA LTD
CONSULTING ENGINEERS AND PLANNERS

NATURAL DRAINAGE CHANNELS

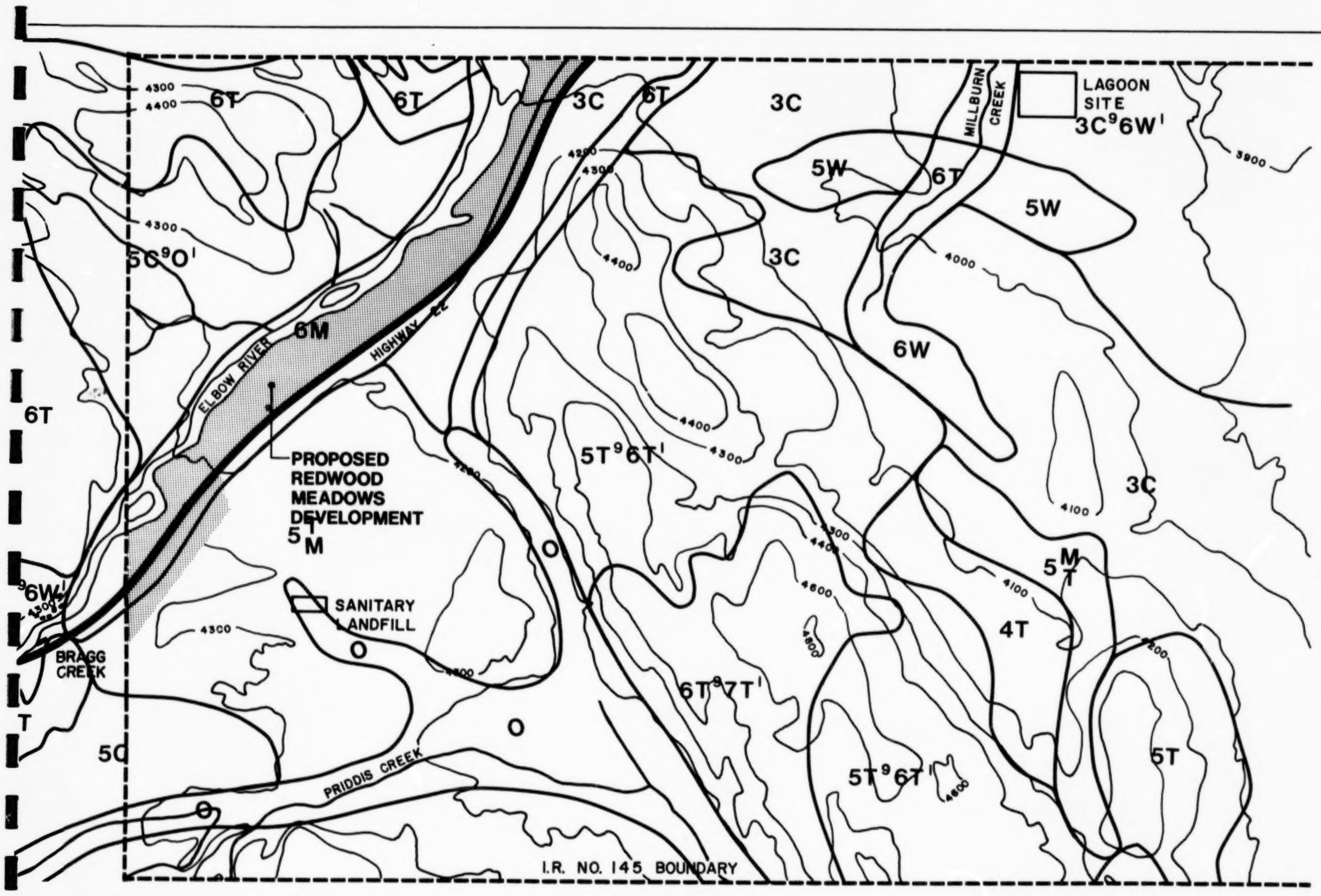
DITCHING – ADJ. TO ROADS AND DYKES

4.3

0 50 100 250m

REDWOOD MEADOWS MASTER PLAN

SURFACE DRAINAGE


4300
4400
6T
6T
3C
6T
3C
MILLBURN CREEK
LAGOON SITE
3C⁹6W¹
3800
5W
6T
5W
4200
4300
4300
3C
4000
5C⁹O¹
4400
6M
ELBOW RIVER
HIGHWAY 22
6W
6T
4400
4300
PROPOSED
REDWOOD
MEADOWS
DEVELOPMENT
5T⁹6T¹
4200
4100
3C
5 T/M
O
4300
4400
4600
5 M/T
4100
6W
SANITARY LANDFILL
4300
4T
BRAGG CREEK
O
4800
4200
6T⁹7T¹
4600
T
5C
O
5T
PRIDDIS CREEK
5T⁹6T¹
4600
O
I.R. NO. 145 BOUNDARY

AGRICULTURAL CAPABILITY CLASSIFICATION

1 - No significant limitations
2 - Moderate limitations
3 - Moderately severe limitations
4 - Severe limitations
5 - Very severe limitations
6 - Perennial forage crops only
- No capability
9 - Swamp (organic)

LIMITING SUBCLASSES

C - Climate	P - Stoniness
D - Soil Structure	R - Bedrock
E - Erosion	S - Soil Character
F - Fertility	T - Topography
I - Inundation	W - Water
M - Moisture	X - Miscellaneous
N - Salinity	

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$5\frac{9}{T}$ ← 90% of area is Class 5
Adverse topography limits soil agricultural capability

$6\frac{1}{T}$ ← 10% of area is Class 6
adverse topography limits soil agricultural capability

5.2

0 500 1000m

REDWOOD MEADOWS MASTER PLAN

AGRICULTURAL CAPABILITY

4.8.3 Future Dyking

To protect future development areas, dykes as recommended by the PFRA report will be required. The dyke alignment as proposed by PFRA in development Areas 2 and 3 has been altered slightly in order to obtain more developable land. The 1923 flood line as mapped by PFRA included some scour channels that were a considerable distance from the active River. Some of these lands between the flood channels and the River were not flooded during the 1923 flood.

As discussed in the previous section, Klohn Leonoff Consultants Ltd. are presently reviewing and recalculating the back water curves to re-determine the dyke heights as proposed by PFRA. The dyke heights may vary slightly due to the differing alignment of the existing dyke, the realignment of the dyke adjacent to Area 2, and the deepening of the River channel due to removal of dyke materials from the River bed.

Recommendations on dyke protection will also be provided in the report by Klohn Leonoff Consultants Ltd.

4.9 CONSTRUCTION COST ESTIMATE

4.9.1 General

The cost estimates as outlined in Table 4.4 are based, where possible, on 1980 City of Calgary construction costs. Cost breakdowns are given for each development area, and listed in order of the probable construction sequence. Costs given are estimated values only.

TABLE 4.4

ESTIMATED CONSTRUCTION COSTS

	QUANTITY	COST(1980 $)	TOTAL
Area 4			
- Install Additional Pump	1	$ 10,000	$10,000
Area 5			
- Watermains	3100 m	$550,000	
- Sewer lines	3000 m	$525,000	
- Roads - local	1750 m	$400,000	
- collector	1650 m	$450,000	
- Dykes	2000 m	$300,000	
- Shallow utilities/lights	L.S.[1]	$250,000	
- Drainage - culverts	L.S.	$ 25,000	$2,500,000
Area 6			
- Pressure Reducing Valve	1	$ 10,000	
- 1800 m^3 Reservoir	1	$300,000	
- Watermains	4000 m	$700,000	
- Sewer lines	2500 m	$440,000	
- Force main	200 m	$ 35,000	
- Shallow utilities/lights	L.S.	$220,000	
- Roads - local	1750 m	$400,000	
- collector	625 m	$175,000	
- Dykes	1000 m	$150,000	
- Drainage	L.S.	$ 20,000	$2,450,000
Area 3			
- Watermains	4400 m	$770,000	
- Sewer lines	3750 m	$660,000	
- Roads - local	2300 m	$520,000	
- collector	1600 m	$440,000	
- Dykes	2700 m	$405,000	
- Shallow utilities	L.S.	$260,000	
- Drainage	L.S.	$ 25,000	$3,080,000
Area 2			
- Booster Station	L.S.	$ 75,000	
- 1900 m^3 Reservoir	L.S.	$350,000	
- Watermains	5200 m	$910,000	
- Sewer lines	3125 m	$550,000	
- Shallow utilities	L.S.	$225,000	
- Roads - local	1600 m	$360,000	
- collector	2400 m	$660,000	
- Drainage	L.S.	$ 25,000	$ 3,155,000
Area 1			
- Watermains	400 m	$ 70,000	
- Sewer lines	1300 m	$275,000	
- Roads - local	400 m	$ 90,000	
- collector	1000 m	$275,000	
- Shallow utilities	L.S.	$115,000	
- Drainage	L.S.	$ 15,000	$ 840,000
	TOTAL		$12,035,000

[1] Lump Sum

5 ENVIRONMENTAL ASSESSMENT

5.0 ENVIRONMENTAL ASSESSMENT

5.1 INTRODUCTION

The purpose of this section is to provide a general inventory of the existing environment within and surrounding the Redwood Meadows community and to predict the impacts of the development on the physical and biological elements of that environment.

The scope of this investigation will be limited to general considerations of environmental elements with information obtained from existing sources. Although field observations are made, no quantitative sampling of water quality, ambient air, benthic fauna, fish, etc. has been attempted. Impacts of the proposed development are predicted and rated on a comparative qualitative scale rather than on a specific numerical scale. Social and economic impacts of the development are not dealt with in this study.

The methodology used for this analysis is as follows:

- *a) Provide a brief description of the proposed project;*
- *b) Provide an inventory of existing physical and biological elements within and surrounding the proposed site;*
- *c) Formulate a prediction of the impacts of the scheme on the existing environment and point out any mitigating features of the development which would reduce negative impacts and enhance positive impacts, and,*
- *d) Identify any data gaps which should be the subject of further study and describe any residual impacts. Recommend any monitoring programs which would give some advance warning of adverse residual impacts.*

5.2 PROJECT DESCRIPTION

The proposed development is thoroughly described in Sections 3.0 and 4.0 of this plan. However, for the sake of assessing the environmental impacts, a brief summary of the project's statistics is presented below.

The development will encompass approximately 445 hectares in the north-west portion of the Sarcee Indian Reserve No. 145 on the easterly side of the Elbow River. Within this area it is proposed to develop approximately 876 single family lots (each approximately 0.14 hectares), 179 medium density units, one or more schools, commercial shopping facilities, two recreation centres, parks, trails, and an 18-hole golf course. The estimated total population of the development is 4,041 persons. The estimated utility requirements from the project are:

- *a) Average daily sanitary sewage flow - 2,200 cubic metres/day;*
- *b) Average daily water consumption - 1,800 cubic metres/day;*
- *c) Total solid waste generation - 6,000 kg/day or 45 cubic metres/day, and*
- *d) Increase in runoff - 5 cubic metres/sec.*

The project will be developed at a low density and in such a fashion as to maintain as much of the natural beauty of the area as possible.

5.3 EXISTING BIOPHYSICAL ENVIRONMENT

5.3.1 Biophysical Setting

a) Landforms and Surficial Materials

The proposed community lies in gently rolling terrain at the base of the Rocky Mountain foothills. Elevations and hydrologic features are shown on Map 5.1. The area consists mainly of the Elbow River Valley and low-lying flood plain at an elevation of approximately 1200 metres and a ridge of hills to the east rising to approximately 1500 metres. Below this ridge to the east the terrain is gently rolling and elevations are generally below 1200 metres.

Geotechnical information is reported in a study entitled Redwood Meadows Geotechnical Investigation, by Klohn Leonoff Consultants Ltd., May, 1980.

The flood plain (mostly on the south side of the Elbow River) is composed generally of River deposited granular materials consisting of gravel and sand, overlain in places by a variable thickness of silt and sand deposits. The north bank of the River is formed by steep slopes of bedrock or resistant glacial deposits. The surficial deposits are believed to be underlain by sedimentary rocks belonging to the Brazeau Formation and/or the Alberta Group of Upper Cretaceous age.

b) Vegetation

The predominent species within the Redwood Meadows area is White Spruce and these are limited in areas where flooding occurs. On the north and east sides of the development area White Spruce is interspersed with trembling Aspen. To the south of the area Lodgepole Pine is predominant with some White Spruce. Several treeless meadows are evident on southern exposures.

Willows and shrubs typical of occasionally inundated areas are evident at lower elevations.

c) Drainage

The major drainage in the area is the Elbow River. The River picks up several small unnamed creeks within the area, most of which appear to be ephemeral except for Bragg Creek. Other minor channels have been formed within the actual flood plain and these appear as a complex system of interconnecting "Scars".

There is evidence that the River has shifted its course through lateral bank erosion, minor in some areas and substantial in other areas where more erodible materials exist and over-bank flow has taken place.

The Priddis Creek drainage flows generally south-east and away from the development area.

d) Climate and Air Quality

The nearest climatological station is at Calgary International Airport which has over 85 years of recordings. A summary of these recordings is given on Table 5.1. Wind data is shown on Table 5.2.

5.3.2 Land Use and Capabilities

a) Agriculture and Grazing

Map 5.2 shows the Canada Land Inventory soil classification for agricultural capability in the study area. The entire proposed development area has a Class 6 capability, i.e. perennial forage crops only and improvement practices are not feasible. The limiting factor is moisture.

Lands surrounding the proposed development are classed as 6 or 5. Class 5 has very severe limitations that restrict capability of producing forage crops. The restricting factors in these areas are topography and/or climate.

The area in the Priddis Creek drainage is shown as organic soils and not placed in capability classes.

A small area to the north-west and several areas to the north-east of the development are placed in capability Class 3. Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices, or both. These soils are low to fair in productivity for a reasonable range of crops but may have high productivity for a specially adapted crop. The restricting factor in these areas is adverse climate, low temperature, and low rainfall during the cropping season.

b) Forestry

Map 5.3 shows the Canada Land Inventory classification within and surrounding the proposed development area for forestry capability.

The development area is classified as 70% with a Class 5 capability and 30% with a Class 7 capability. A Class 5 area has severe limitations to the growth of commercial forest. In this case, growth is limited because of excess moisture at times of flood and too little moisture at other times. Productivity in a Class 5 area might be from 2 to 3.5 cubic metres per hectare per year.

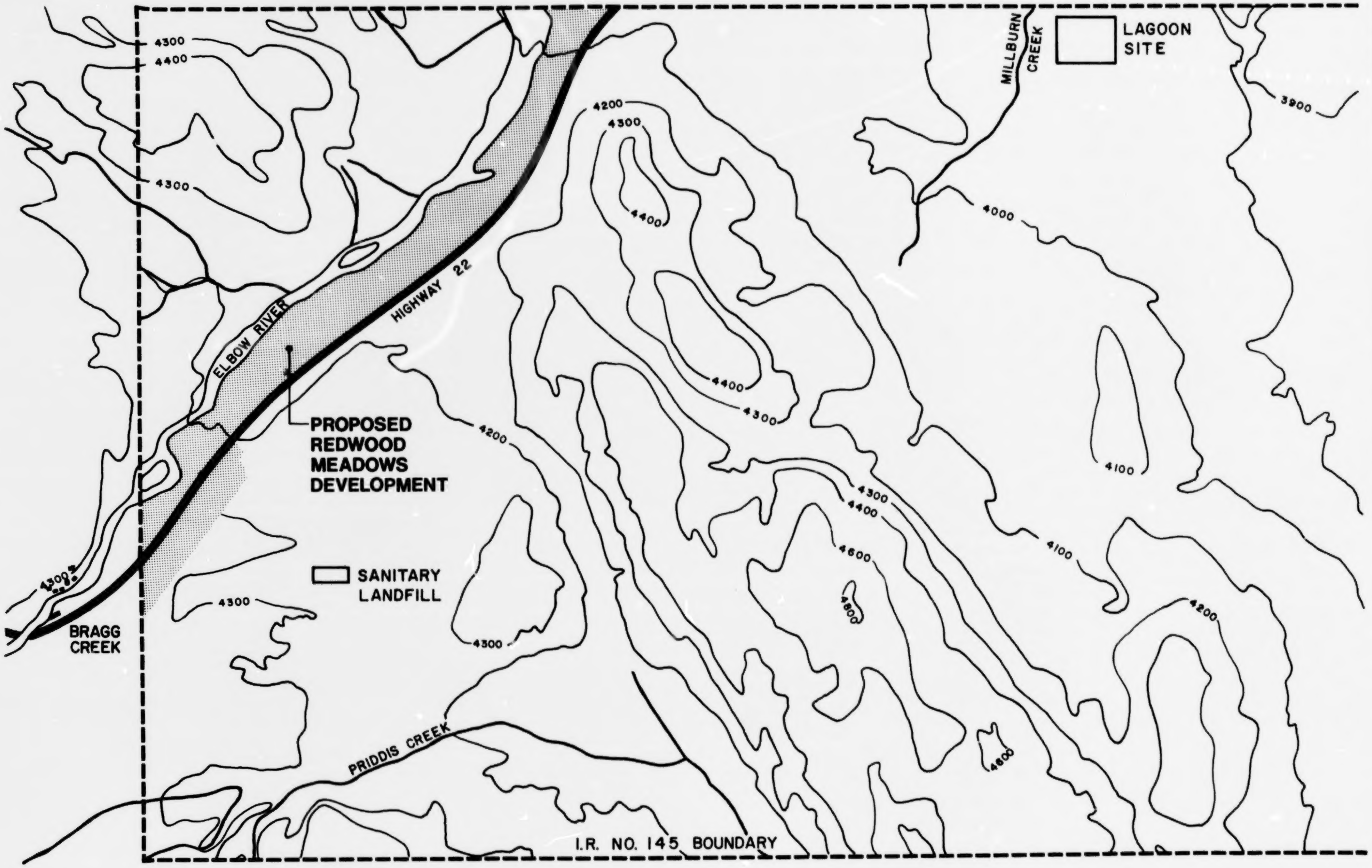
A Class 7 area has such severe limitations that the growth of commercial forests is precluded. Productivity would be less than 0.7 cubic metres per hectare per year. The areas surrounding the proposed development are also Class 5 to Class 7 in varying proportions with the limiting factors being either adverse moisture conditions or shallowness to bedrock.

A few smaller areas to the south have a small percentage of Class 4 lands. These lands have moderately severe limitations to production and might produce up to 5 cubic metres per hectare per year. No parts of the study area are suitable for practical commercial timber harvesting.

c) Land Status and Heritage

All of the land proposed to be developed lies within Indian Reserve No. 145. The land will remain in the Reserve and sold on a leasehold basis.

There are a number of historic sites within the reserve of some archeological significance. However, within the proposed development area no sites have been identified as having any significant historical or heritage value.


4300
4400
4300
LAGOON SITE
MILLBURN CREEK
3900
4200
4300
4400
4000
ELBOW RIVER
HIGHWAY 22
PROPOSED REDWOOD MEADOWS DEVELOPMENT
4400
4300
4200
4100
4300
4400
4100
4600
4800
SANITARY LANDFILL
4300
BRAGG CREEK
4300
4300
4200
PRIDDIS CREEK
4600
I.R. NO. 145 BOUNDARY

5.1

REDWOOD MEADOWS MASTER PLAN

SITE TOPOGRAPHY & DRAINAGE

0 500 1000m

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TABLE 5.1

CLIMATOLOGICAL DATA

CALGARY INTERNATIONAL AIRPORT LATITUDE 51 06 N LONGITUDE 114 01 W ELEVATION 3540 FT ASL

MONTH	J	F	M	A	M	J	J	A	S	O	N	D	YR	
MEAN DAILY TEMP (DEG F)	12.3	18.6	24.3	38.0	48.8	55.7	61.7	59.4	51.2	42.2	27.3	18.4	38.2	1
MEAN DAILY MAXIMUM TEMP	22.5	29.1	34.3	49.2	60.6	66.9	74.3	72.0	63.4	54.1	37.7	28.9	49.4	1
MEAN DAILY MINIMUM TEMP	2.0	8.0	14.3	26.8	37.0	44.4	49.1	46.8	39.0	30.2	16.9	7.9	26.9	1
EXTREME MAXIMUM TEMP	61	66	73	85	90	95	97	96	92	85	71	67	97	1
NO. OF YEARS OF RECORD	86	86	86	86	86	86	87	87	87	87	87	87		1
EXTREME MINIMUM TEMP	-48	-49	-35	-22	2	26	31	28	8	- 8	-31	-45	-49	1
NO. OF YEARS OF RECORD	85	86	86	86	86	85	87	87	87	87	87	87		
NO. OF DAYS WITH FROST	30	27	30	23	9	*	*	*	6	18	28	30	201	1
MEAN RAINFALL (INCHES)	0.01	0.01	0.03	0.31	1.60	3.52	2.69	2.20	1.09	0.27	0.03	T	11.75	1
MEAN SNOWFALL	7.5	8.4	8.5	9.5	3.9	0.9	0.0	T	3.1	5.2	6.9	6.7	60.6	1
MEAN TOTAL PRECIPITATION	0.67	0.78	0.80	1.16	1.96	3.61	2.69	2.20	1.39	0.74	0.63	0.58	17.21	1
GREATEST RAINFALL IN 24 HRS	0.30	0.25	0.92	1.46	2.56	3.12	3.75	3.18	2.65	1.80	0.22	0.25	3.75	1
NO. OF YEARS OF RECORD	87	86	87	86	85	85	87	87	87	87	88	88		
GREATEST SNOWFALL IN 24 HRS	10.0	10.9	9.5	18.0	19.0	9.8	0.1	2.4	9.0	11.7	14.0	8.6	19.0	1
NO. OF YEARS OF RECORD	87	85	87	86	86	86	87	87	87	87	88	88		
GREATEST PRECIPITATION IN 24 HRS	1.00	1.09	0.95	1.80	2.56	3.12	3.75	3.18	2.65	1.80	1.40	0.86	3.75	1
NO. OF YEARS OF RECORD	87	85	87	86	85	85	87	87	87	87	88	88		
NO. OF DAYS														
WITH MEASURABLE RAIN	*	*	1	3	9	13	11	11	7	3	1	*	59	1
WITH MEASURABLE SNOW	10	9	11	7	3	*	0	*	2	4	7	8	61	1
WITH M. PRECIPITATION	9	9	11	9	11	13	11	11	8	6	7	8	113	1

From Table 5.1:

Maximum mean daily temperature: 23.5°C
Minimum mean daily temperature: -16.7°C
Maximum recorded temperature: 36°C
Minimum recorded temperature: -45°C
Mean annual rainfall: 299 mm
Mean annual snowfall: 1539 mm

TABLE 5.2

WIND DATA

1955-72 PERIOD HEIGHT OF ANEMOMETER 60'

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
PERCENTAGE FREQUENCY													
12	10	10	9	9	9	8	8	9	7	10	10	9	N
3	3	4	4	4	4	3	3	2	2	3	2	3	NNE
2	3	3	4	3	4	3	3	2	2	2	2	3	NE
1	1	1	2	2	2	2	2	1	1	1	1	1	ENE
2	3	4	4	4	4	4	4	3	2	2	2	3	E
2	2	3	3	4	3	4	3	2	2	1	2	2	ESE
6	6	8	7	7	7	8	7	6	5	5	4	6	SE
5	7	9	8	8	7	7	7	7	6	6	5	7	SSE
10	12	10	9	8	7	8	9	10	11	11	10	10	S
6	6	5	5	4	4	4	5	6	8	7	7	6	SSO
6	6	5	5	4	4	5	5	5	7	7	7	6	SO
4	4	4	4	3	3	3	3	3	5	5	5	4	OSO
13	11	9	10	9	8	7	7	9	15	13	12	10	O
3	3	3	4	4	5	4	4	4	4	3	3	4	ONO
6	5	6	7	9	10	10	9	9	6	6	6	7	NO
10	9	9	10	12	13	12	13	14	10	9	12	11	NNO
9	9	7	5	6	6	8	8	8	7	9	10	8	Calm
PERCENTAGE WIND SPEED IN MILES PER HOUR													
11.9	12.5	12.9	13.8	13.6	12.2	10.4	11.0	12.3	12.0	11.9	11.6	12.2	N
10.4	10.7	11.9	12.9	12.3	12.2	10.5	10.4	11.0	10.7	9.7	9.4	11.0	NNE
6.8	7.6	8.3	10.2	9.3	10.4	7.9	8.3	7.6	8.4	7.1	6.8	8.2	NE
6.7	7.3	8.2	10.5	10.5	10.1	9.3	8.2	9.0	8.5	6.9	6.9	8.5	ENE
6.2	7.6	8.4	10.3	9.8	9.3	8.8	8.1	9.1	7.4	6.3	6.5	8.2	E
7.6	9.3	10.3	10.8	11.8	10.7	10.5	9.1	9.4	8.4	8.1	7.3	9.4	ESE
8.1	8.4	9.7	10.8	11.8	10.7	9.8	9.3	9.4	9.3	8.0	7.8	9.4	SE
8.9	9.1	10.3	11.9	12.5	11.7	10.7	10.4	10.4	10.7	8.9	8.8	10.4	SSE
7.5	7.9	8.5	9.2	9.4	9.3	8.4	8.2	8.4	8.4	7.6	7.8	8.4	S
7.4	7.5	7.4	8.4	8.1	8.5	7.6	7.5	7.6	7.9	7.5	7.4	7.7	SSO
7.7	7.5	7.2	8.0	7.5	7.3	7.1	6.9	6.5	7.8	7.3	7.8	7.4	SO
13.9	13.4	12.3	12.6	10.4	11.1	9.8	10.2	10.8	13.1	13.0	14.4	12.1	OSO
19.4	18.8	17.2	17.0	15.9	15.3	13.2	13.3	16.0	17.3	18.3	18.1	16.7	O
14.2	14.2	14.2	15.0	13.6	13.3	12.0	11.8	13.4	14.2	12.8	14.0	13.6	ONO
9.6	9.8	10.1	11.3	11.7	11.4	10.3	9.3	11.5	10.7	9.2	9.5	10.4	NO
12.3	13.1	12.7	14.7	15.3	13.2	11.5	11.6	14.3	13.8	12.7	13.9	13.3	NNO
DIRECTIONS													
10.1	10.0	10.3	11.6	11.5	10.9	9.4	9.1	10.2	10.6	9.9	10.0	10.3	

Prevailing winds are from the north northwest with an average speed of approximately 27 kph.

No air quality data has been identified for the Redwood Meadows area.

d) *Wildlife*

i) *Ungulates*

Deer are the predominant species in the Reserve with moose and elk also abundant in many areas. Map 5.4 shows the Canada Land Inventory classification for ungulate capability in the area. The area generally has a capability Class 3, which indicates slight limitations to production with productivity reduced in some years. Limitations in the proposed development area are mainly due to poor soil moisture and lack of nutrients in the soil for optimum plant growth. In the higher elevations east of the development area productivity is further limited by exposure to prevailing winter winds which adversely affects the animal's habitat. This area has been given a lower capability Class of 4, which indicates moderate limitation to production. A small important winter range is identified south of the Reserve, but no winter ranges are indicated within the study area.

ii) *Bears*

Black bear is present in relatively low numbers; grizzly bear is rarely encountered.

iii) *Other Carnivores*

Lynx, coyote and cougar have been periodically encountered; there is no direct evidence of wolves or wolverine, ermine, weasel or mink.

iv) *Aquatic Furbearers*

Beaver appears to be well established in some areas; there is no direct evidence of muskrat or otter aquatic furbearers although minor numbers are expected in valley bottoms.

v) *Waterfowl*

Map 5.5 shows the Canada Land Inventory classification for waterfowl capability in the area. All of the study area is classed between Class 6 and Class 7. Class 6 has severe limitations to waterfowl production. The limitations in this case are topography, the existence of free flowing water and the absence of standing water bodies. Class 7 lands have such severe limitations that almost no waterfowl are produced.

vi) *Upland Game Birds*

Pheasant and partridge are found in varying quantities throughout the reserve; spruce grouse are common in the valley bottoms while blue grouse are present along the crests. A few raptorial species may be present in minor numbers. No rare or endangered species have been identified.

e) *Recreation*

The Canada Land Inventory classifies the area between Class 4 and Class 5, i.e. having moderate to moderately low capability for outdoor recreation.

The main features of the area amenable to recreational activities are the vegetation, topography, and land-water configurations.

The area has high potential for hunting but this is limited to members of the Indian Band or others under special permits. The area has moderate potential for camping, hiking, photography and nature study. The upper regions have vegetation, rock formations, and viewpoints of relatively high significance as a visual resource. The valley bottoms have vegetation and water bodies of moderate significance as a visual resource.

Angling is practiced in the Elbow River but only by residents on the Reserve. Boating, and downhill skiing are not commonly practiced, although the area has good potential for cross-country skiing.

Man-made recreational facilities such as a golf course and recreation centre, including arena, etc. are to be incorporated in the proposed residential community.

5.3.3 *Aquatic Systems*

a) *Surface Water*

The main body of surface water within the study area is the Elbow River. Flow data recorded by Water Survey of Canada at a Station (No. 05BJ004) near the Bragg Creek bridge goes back to 1935 for maximum daily discharge. For minimum daily discharge and total discharge the records go back to 1952.

The flow data from 1952 to 1976 may be quickly summarized as follows:

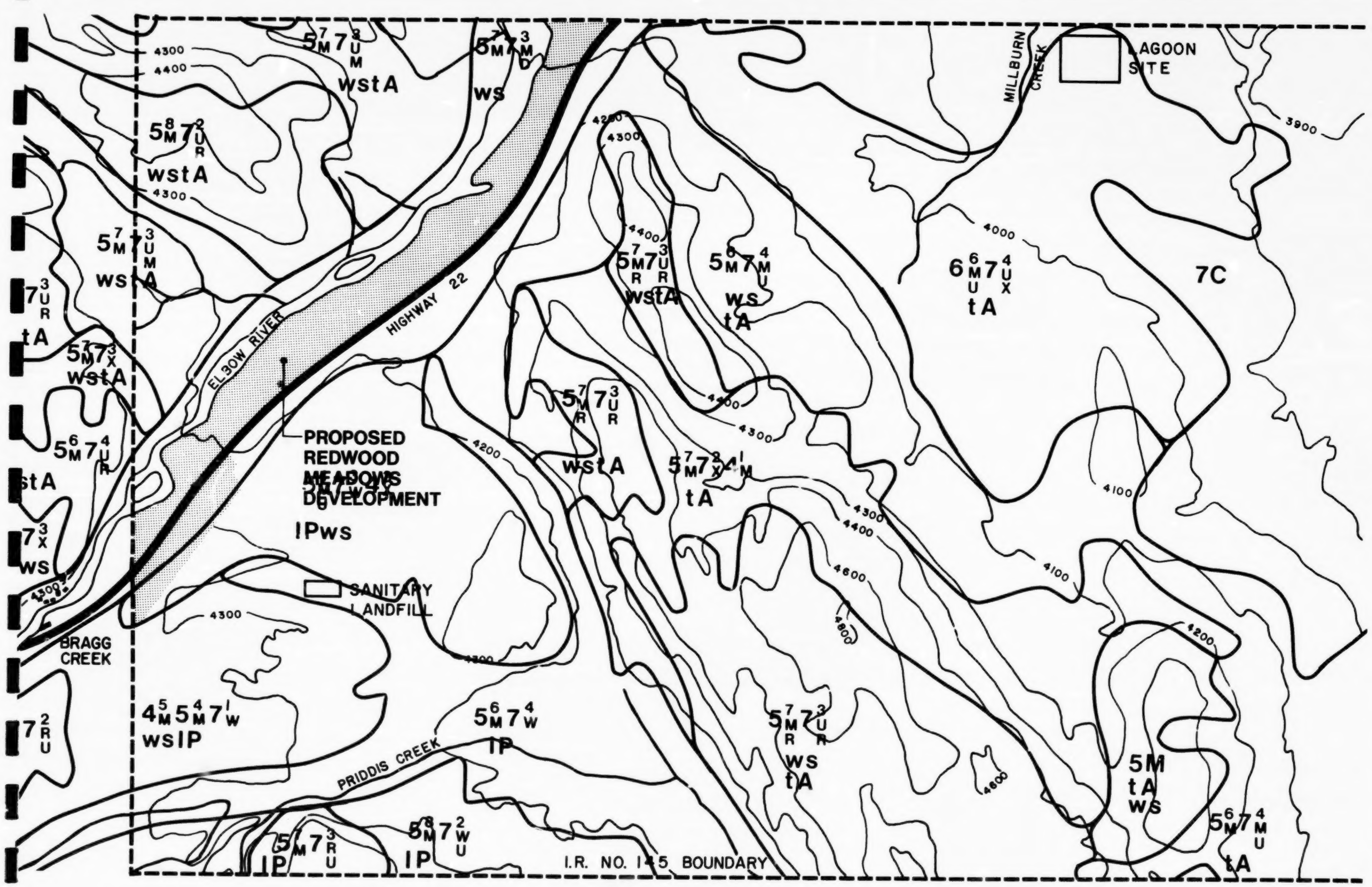
Maximum Daily Discharge:	Low:	26 cms June 16, 1962
	High:	254 cms May 31, 1967
	Mean:	69 cms
Minimum Daily Discharge:	Low:	0.8 cms March 11, 1960
	High:	3.7 cms March 6, 1952
	Mean:	2.3 cms
TOTAL ANNUAL DISCHARGE:	Low:	176 x 10^6 cm, 1960
	High:	369 x 10^6 cm, 1953
	Mean:	239 x 10^6 cm

Water quality in the Elbow River was measured through the year 1979 by the Alberta Pollution Control Branch. Samples were taken at two stations: one below the Bragg Creek Provincial Park and the other at Highway No. 22. A summary of some of the parameters measured is given on Table 5.3. This data was provided by the Water Quality Control Branch but has not yet been published. Since the data is preliminary only, it may be subject to further revision. The table reveals that there are no significant changes to the parameters measured at the two stations. Water quality in the Elbow River appears to remain virtually constant through the Redwood Meadows area from the Bragg Creek bridge to Highway No. 22.

TABLE 5.3

WATER QUALITY

Parameter (units)	STN Below Bragg Ck. Provincial Park		STN at Highway No. 22	
	High Value	Low Value	High Value	Low Value
Temperature (^oC)	14.0	1.0	14.0	2.0
ph	8.5	7.8	8.5	7.7
Conductivity (µs/cm)	419	295	440	292
Alkalinity $CaCO_3$ (mg/1)	180	107	149	111
Hardness $CaCO_3$ (mg/l)	223	150	233	150
Calcium Ca (mg/l)	62.1	40.2	65.2	40.2
Magnesium Mg (mg/l)	17	11	17	11
Sodium Na (mg/l)	3	1	7	1
Potassium K (mg/l)	0.6	0.3	0.9	0.3
Sulphate SO_4 (mg/l)	77	36	89	36
Fluoride F (mg/l)	0.43	0.22	0.95	0.20
Dissolved oxygen (mg/l)	12.5	8.7	12.8	9.2
Dissolved Nitrogen (mg/l)	0.257	0.031	0.121	0.027
Turbidity (jtu)	13	1	17	1
Total Dissolved Solids (mg/l)	234	162	262	161
Reactive Silicon SiO_2 (mg/l)	4.6	3.5	4.8	3.5
Fecal Coliforms (No/100 ml)	49	0	49	0
Total Coliforms (No/100 ml)	110	0	130	2


ELBOW RIVER
HIGHWAY 22
MILLBURN CREEK
LAGOON SITE
PROPOSED REDWOOD MEADOWS DEVELOPMENT
SANITARY LANDFILL
BRAGG CREEK
PRIDDIS CREEK
I.R. NO. 145 BOUNDARY
7C
IPws
wstA
ws
tA
IP
5M tA ws
4300
4400
4200
4100
4000
3900
4600
4800

FORESTRY CAPABILITY CLASSIFICATION

1 - No important limitations
2 - Slight limitations
3 Moderate limitations
4 - Moderately severe limitations
5 - Severe limitations
6 - Very severe limitations
7 - No commercial forest growth

LIMITING SUBCLASSES

A	Aridity	Y	Soil Compactness
C	Climate	E	Erosion
H	Low Temperature	F	Fertility
U	Exposure	I	Inundation
M	Deficient Moisture	L	Calcium
W	Excess Moisture	N	Toxic Elements
X	Mix of M&W	P	Stoniness
D	Dense Soil	S	Soil Combinations
R	Bedrock		

SPECIES

WS	White Spruce	JP	Jack Pine
BS	Black Spruce	AF	Alpine Fir
ES	Englemann Spruce		
TA	Tembling Aspen		
IP	Lodgepole Pine		

IP ws

$5^{4}_{\substack{M\\U}}\ 7^{3}_{W}\ 4^{3}_{X}$

40% of area is Class 5
deficient soil moisture and exposure limit productivitiy
lodgepole pine & white spruce are the indicator species

30% of area is Class 7
excess soil moisture limits productivity

30% of area is Class 4
pattern of deficient & excess soil moisture limit productivity
lodgepole pine & white spruce are the indicator species.

REDWOOD MEADOWS

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5.3

0 500 1000m

REDWOOD MEADOWS MASTER PLAN

FORESTRY CAPABILITY

b) Ground Water

Ground water monitoring was carried out by R. M. Hardy and Associates Ltd. during July and August, 1975. The 1975 program confirmed that groundwater table fluctuation is strongly influenced by the water levels in the nearby Elbow River. The 1975 results indicate a high water table occurring in late June at an average depth of 1.8 metres from the ground surface and a low water table in late August at an average depth of 2.3 metres from the ground surface.

Piezometer readings at 21 test holes have been taken during the period May to October 1980 and these are illustrated on Table 5.4[1]. The results indicate that the water table is high in May and, in most cases, drops steadily through the summer or remains relatively constant. At the upstream end of the Elbow River the water table is generally 4 metres below the ground surface while at the downstream end it varies from 2 to 3 metres. Since the water table appears to be directly related to flows in the Elbow River, development of the area and increase of impermeable surfaces should not significantly affect water table elevations. Readings of the piezometers are expected to continue through to the spring of 1981.

The lowest water table elevations are expected during February to April with maximum depths of up to 5 metres from the ground surface. The highest water table elevations are expected during May to July with the water table coming to 1 metre from the ground surface in a year with high spring run-off, or above the ground surface if the flood plain is inundated.

TABLE 5.4

GROUNDWATER TEST HOLE READINGS

Test Hole	May 6	May 27	June 26	July 11	July 20	Sept. 6	Sept. 14	Sept. 28	Oct. 5
01	1.3	1.0	0.87	1.27	1.35	1.4	1.37	1.37	1.37
02	3.6	3.65	4.01	4.17	4.32	4.27	4.27	4.32	4.32
03	4.2	4.2	4.34	4.57	4.84	4.75	4.70	4.70	4.70
05	2.1	2.0	1.90	2.23	2.23	2.51	2.51	2.49	2.49
06	2.1	2.05	2.51	2.67	2.77	2.95	2.95	2.97	2.97
07	2.7	2.6	2.50	2.72	2.84	3.02	2.97	3.00	2.98
08	2.8	2.1	2.49	2.79	3.20	3.01	3.0	3.0	3.0
09	3.3	2.8	2.87	3.22	3.30	3.58	-	-	-
10	3.15	2.5	3.10	3.30	3.38	3.43	3.43	3.43	3.43
11	4.2	2.0	2.23	2.49	2.59	2.69	2.71	2.74	2.77
12	2.1	1.9	2.13	2.54	2.54	2.59	2.57	2.57	2.61
13	3.45	3.05	3.66	3.73	3.79	4.01	4.04	3.89	3.89
14	1.8	1.4	-	-	-	-	-	-	-
15	1.8	1.5	1.88	2.00	2.00	-	-	-	-
16	Dry	3.8	3.32	3.40	3.40	3.56	3.58	3.56	3.56
17	4.2	3.5	3.91	4.44	4.52	4.44	4.46	4.42	4.44
18	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
19	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
20	2.4	1.85	2.36	2.51	2.49	2.67	2.51	2.49	2.50
21	4.8	4.55	below 5.0	below 5.0	below 5.0	below 5.0	below 5.0	below 5.0	below 5.0
22	4.95	4.45	-	4.23	4.34	4.72	4.78	4.78	4.81

1. Readings are in metres below ground surface.
2. Test hole locations are shown on Maps 2.1 to 2.6.

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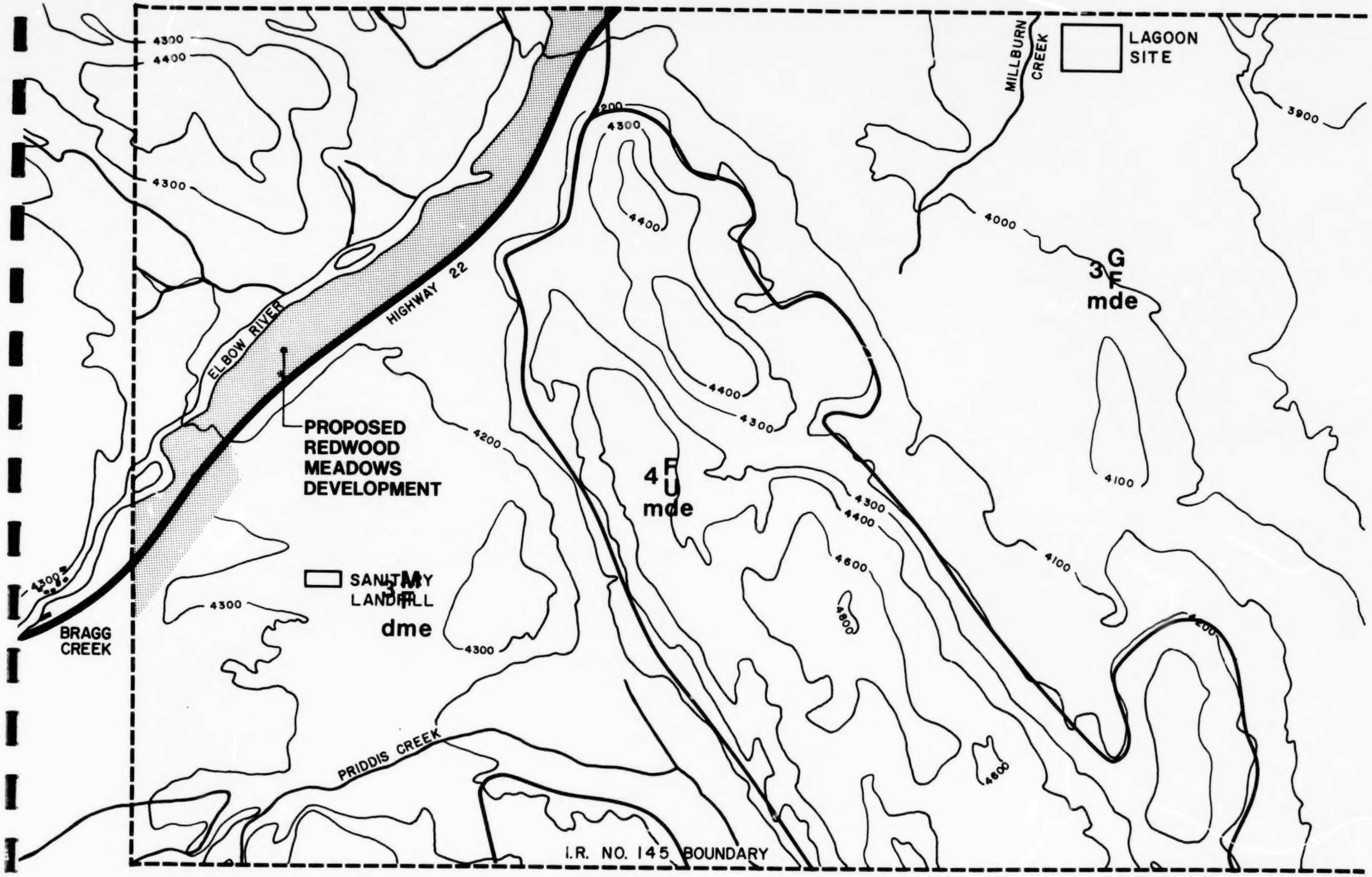
[1] See also Section 2, Tables 2.2, 2.4, 2.6, 2.9, and 2.11. Maps 2.1 to 2.6 identify the locations of the test holes.



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ELBOW RIVER
HIGHWAY 22
PROPOSED REDWOOD MEADOWS DEVELOPMENT
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SANITARY LANDFILL
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PRIDDIS CREEK
I.R. NO. 145 BOUNDARY
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4600
MILLBURN CREEK
LAGOON SITE
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4000
3 G F mde
4100
4100
4200

UNGULATE CAPABILITY CLASSIFICATION

I	No significant limitations
IW	Very important winter range
2	Very slight limitations
2W	Important winter range
3	Slight limitations
3W	Moderately important winter range
4	Moderate limitations
5	Moderately severe limitations
6	Severe limitations
7	No ungulate production

LIMITING SUBCLASSES

A	Aridity	G	Landform
C	Climate	I	Inundation
Q	Snow Depth	M	Soil Moisture
U	Exposure	N	Adverse Soil
F	Fertility	R	Soil Depth
		T	Topography

SPECIES

a	Antelope	g	Mountain goat
c	Caribou	m	Moose
d	Deer		
e	Elk		

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4 F U mde ← Area is Class 4
– moderate limitations to ungulate production due to infertile soil for plant growth and exposure or aspect that adversely affects habitat

mde ← moose, deer and elk are the indicator species

5.4

0 500 1000m

REDWOOD MEADOWS MASTER PLAN

UNGULATE CAPABILITY

The quality of the groundwater was measured in 1975 and results indicate the following average parameters:

	RANGE
Sulphate (mg/l)	*74-329*
Chloride (mg/l)	*19-76*
Iron (mg/l)	*less than 0.05*
Free CO_2 *(mg/l)*	*2-6*
Hydrogen Sulfide (mg/l)	*less than 0.01*
Nitrate (mg/l)	*1.33-4.87*
Hardness (calcium)(mg/l)	*63-86*
Total Dissolved Solids (mg/l)	*292-422*
Conductance (ms/cm)	*370-530*
Temperature (°C)	*5.4-9.0*
ph	*6.4-7.1*

The measured values indicate a water of medium aggressive corrosivity. The two parameters which are noticeably higher than typical groundwater are: sulphates (normally 15-25 mg/l) and chlorides (normally 5-10 mg/l).

c) Fish

The Canada Land Inventory classifies the area as 90% Class 2 and 10% Class 4, as shown on Map 5.6. Class 2 has few minor limitations to fish production and Class 4 has numerous severe limitations.

The Class 2 area is mainly in and around the Elbow River where conditions are good for sport fish production except for some adverse effects created by past land-use in the drainage basins. The remaining Class 4 area is severely affected not only by past land use but also by streams which are intermittent and consequently limit sportfish capability.

The Elbow River contains various species of cold water fish including brook trout and rainbow trout. Relatively little data is available on fish species in the area or their habits and habitat, but it is believed that upstream tributaries of the Elbow River are used for spawning. Brook trout normally spawn in August/September and hatching and emergence normally occur in March/April. Further study would be required to determine number of species present, food availability, seasonal abundance, time and location of spawning, migratory habits and habitat requirements of the species present.

5.3.4 Noise and Hazards

a) Flood

The proposed development area lies within the Elbow River flood plain. Several studies have been carried out related to flooding probability. The studies examined are as follows:

The Probability of Flooding and Potential Erosion in the Elbow River Below Bragg Creek, Report #66 by Prairie Farm Rehabilitation Administration, August 1973;
Assessment of Elbow River Flood and Erosion Potential by Northwest Hydraulic Consultants Ltd. 1975; and

Elbow River Flood Study, by Prairie Farm Rehabilitation Administration, November, 1975.

The reports indicate that active erosion is taking place along the River bank and this is expected to increase with future flooding.

The recommendations put forward by the Prairie Farm Rehabilitation Administration in order to protect the proposed residential development from flooding damage have been adopted. These recommendations are as follows:

i) Construction of a dyke, located outside of the area inundated during the 1923 flood, to a height of 2½ feet above the 500-year flood, or to the elevation of the probable maximum flood, whichever is the higher;

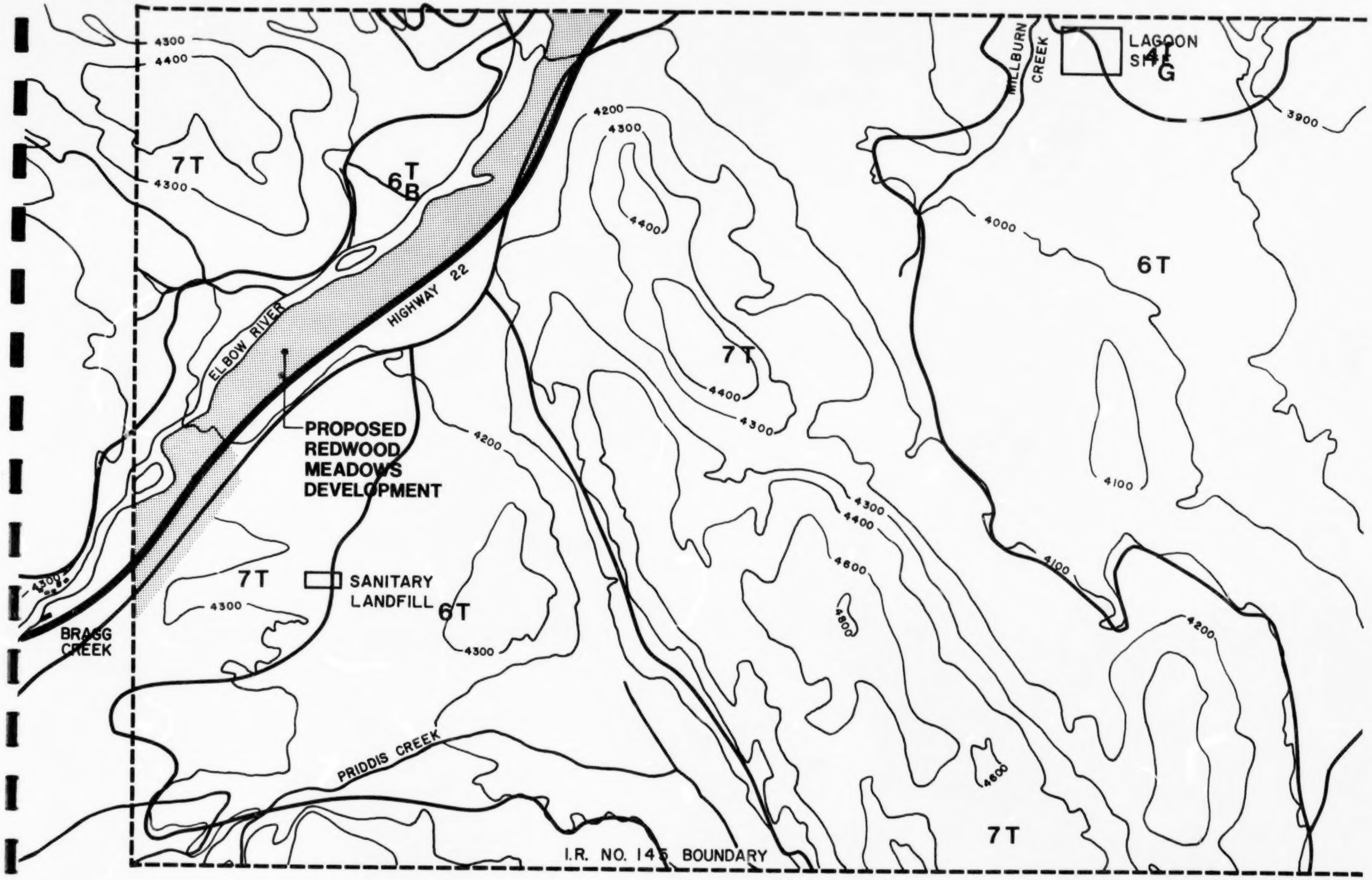
ii) Construction of three transverse dykes from the main dyke to high ground to isolate the development phases;

iii) Provision of heavy riprap slope protection at a number of locations along the dyke where erosion might be expected to occur during floods;

iv) Development and maintenance of a roadway along the top of the main and transverse dykes for emergency access;

v) Maintenance of three stockpiles of riprap in the project area for emergency use; and

vi) Installation of culverts and flap gates under the main dyke at the intersections with major natural drainage channels.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HIGHWAY 22
PROPOSED
REDWOOD
MEADOWS
DEVELOPMENT
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7T
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4200
4300
4400
4600
4800
MILLBURN CREEK
LAGOON SITE
4T/G
3900
4000
6T
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4600
7T
SANITARY LANDFILL
6T
4300
4300
BRAGG CREEK
PRIDDIS CREEK
I.R. NO. 145 BOUNDARY

WATERFOWL CAPABILITY CLASSIFICATION

I - No significant limitations
IA - Very important migration stops
2 - Very slight limitations
2S - Important migration stops
3 - Slight limitations
3S - Moderately important migration stops
3M - Important migration or wintering areas
4 - Moderate limitations
5 - Moderate severe limitations
6 - Severe limitations
7 - Almost no waterfowl produced

LIMITING SUBCLASSES

A - Aridity
B - Free Flowing Water
C - Climate
F - Fertility
G - Landform
I - Inundation
J - Reduced Marsh Edge
M - Soil Moisture
N - Adverse Soil/Water
R - Soil Depth
T - Topography
Z - Water Depth

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6^{T}_{B} ← Area is Class 6 severe limitations to waterfowl production due to adverse topography & presence of free-flowing water

5.5

0 500 1000m

REDWOOD MEADOWS MASTER PLAN

WATERFOWL CAPABILITY

b) Fire

Forest fires have occurred in the area over the years, but mostly of minor significance. A major fire occurred at one time which devastated the entire area now planned for residential development. A reddish aftergrowth occurred in the area, becoming the source of the name "Redwood Meadows".

During prolonged dry periods the area has a high potential for a major forest fire if uncontrolled.

c) Noise

No measurements have been made to determine existing background noise levels. However, the area is observed to be generally serene and country-like. There do not appear to be any noise creating sources in the vicinity with the exception of occasional low-flying aircraft and some traffic noise from the highway.

5.4 PREDICTED IMPACTS

5.4.1 Air Quality

The proposed development will not have any specific sources of emissions to the atmosphere such as a municipal incinerator. Non-point source emissions will occur because of increased vehicle movements and the use of fireplaces and possibly individual trash incinerators. However, because the density of the overall development is very low, it is not expected that these sources will have any significant impact on air quality.

Fugitive dust is expected to arise during the construction period but this will be of short duration, as all roads are to be paved. The impact of the development on air quality is expected to be nil to minor.

5.4.2 Water Quality

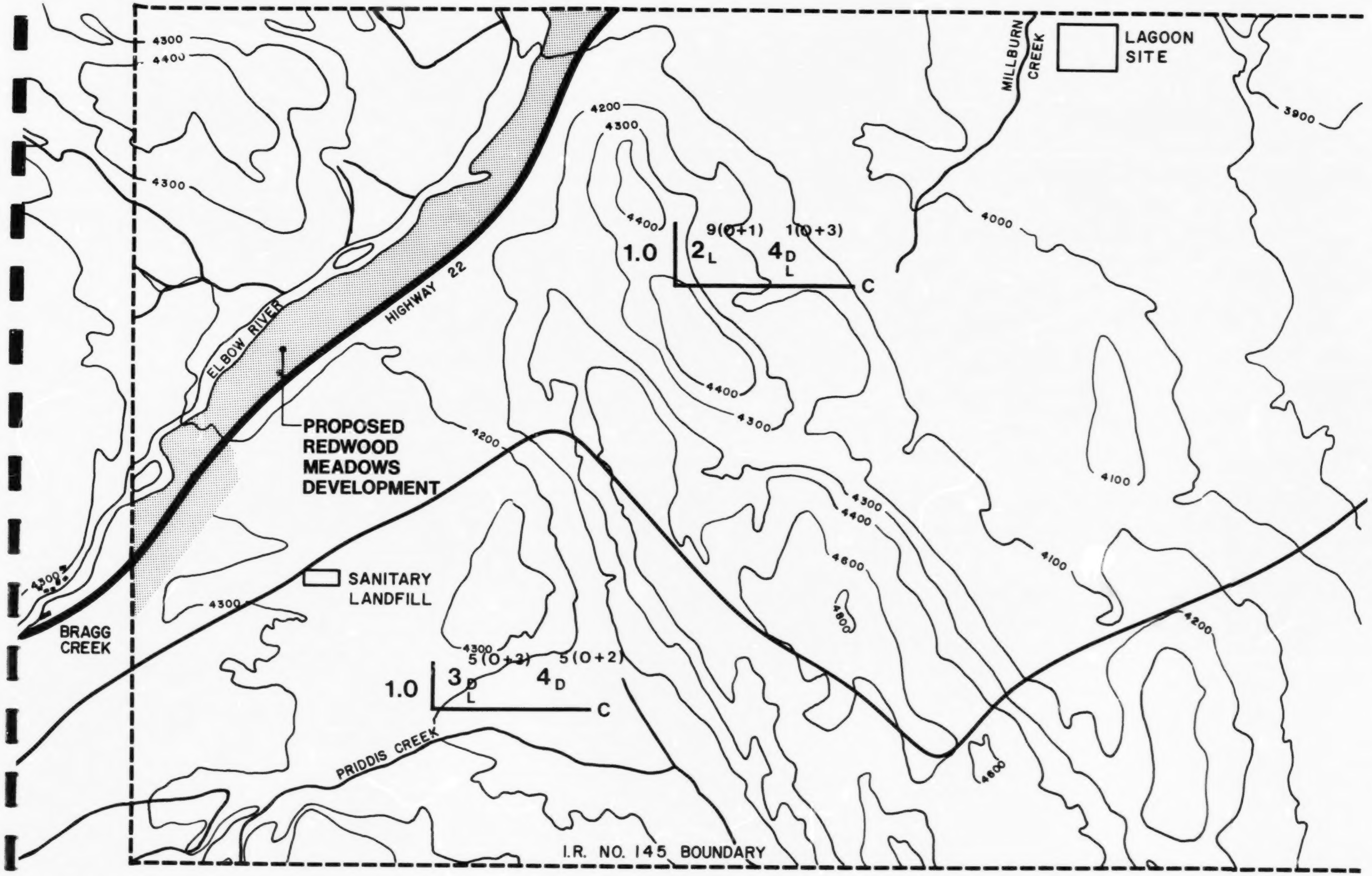
Water quality may be affected by:

- *drawing of excess water from the River;*
- *direct discharge of effluents;*
- *leachates from landfill operations;*
- *surface runoff; and*
- *discharges from construction operations.*

The estimated daily domestic water consumption for the proposed development is 1800 cm per day. The low minimum daily discharge recorded at Bragg Creek bridge is 0.8 cms or 69,120 cm/day. The mean minimum daily discharge recorded is 2.3 cms. or 198,720 cm/day. The water to be drawn from the River represents 2.6% of the lowest recorded flow and 0.90% of the mean minimum daily flow.

Because the domestic demand is such a small percentage of the low flow in the River, the drawing of water is not expected to have any adverse affects on River levels or water quality.

There are no direct discharges of effluents proposed to the Elbow River. The present sewage lagoons are located as shown on Map 5.1. The lagoon effluent is to be spray irrigated to the surrounding hay fields.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ELBOW RIVER
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PROPOSED REDWOOD MEADOWS DEVELOPMENT
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C
PRIDDIS CREEK
4600
I.R. NO. 145 BOUNDARY

SPORT FISH CAPABILITY CLASSIFICATION

1 - No significant limitations
2 - Few limitations
3 - Several minor limitations
4 - Numerous severe limitations

STREAMS LIMITING SUBCLASSES

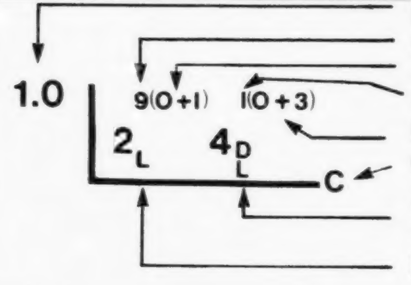
A - Nutrients (lacking)
B - Bank Cover (erosion)
C - Substrate (unclean)
D - Discharge (low)
E - Pools (shallow)
L - Land Use
R - Refuge (shelters)
T - Temperature

LAKES LIMITING SUBCLASSES

D - Depth
F - Wind Exposure
G - Light Penetration
N - Nutrients
O - Oxygen
S - Spawning Areas
T - Temperature

SPECIES INDICATOR

C - Cold Water Species
W - Warm Water Species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1 sq. mile of watershed covered by water
90% of waters are Class 2
No lakes 1 stream
10% of waters are Class 4
No lakes 3 streams
Cold water species
Both low discharge & land use adversely affect fish habitat
Land use has adversely affected fish habitat

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5.6

0 500 1000m

REDWOOD MEADOWS MASTER PLAN

SPORT-FISHING CAPABILITY

The four lagoon cells have enough volume to store one year of the projected sewage flow. However, the last cell, which can store for approximately 290 days, will be used for storage. It is proposed to drain this cell through the spray irrigation season and allow it to refill during the winter months. A sixty-day retention in the aeration cells with subsurface aeration provided by static aerators should ensure that the quality of the effluent will be suitable for irrigation purposes.

The sanitary landfill site is located as shown on Map 5.1. The area is on high ground and there are no streams or other watercourses nearby. The groundwater table in the area is believed to be low. Leadrates from this landfill are not foreseen to create any problems. Surface runoff will increase due to the residential development and this will tend to reduce water quality as silts, oils, leaves, and other organic matter is expected in the runoff water.

Increased runoff is expected to occur during periods of high River flow and consequently, the concentration of any pollutants in the runoff water reaching the Elbow River is expected to be low. Silts and sands in the runoff waters may be high at times during the construction of the development, but this will be of short duration and during the dry season.

5.4.3 Terrestrial Resources

a) Surficial Materials

Major changes will occur on surficial materials locally during construction of the proposed development. However, since the soils are not highly productive for agriculture, grazing or forestry use, the potential loss of soils is not considered to be significant.

b) Vegetation

Selective clearing is to take place during construction of the development but this will be limited to road and dyke rights-of-way. Residential lots are to remain in a natural state and clearing for housebuilding is to be restricted so as to preserve as much of the natural tree cover as possible. The resulting loss of vegetation will not be significant.

c) Wildlife

The imposition of the residential development on the landscape will tend to restrict the movements of ungulates in the area. However, the area is not classed as an important winter range and will not likely prevent access for ungulates travelling to better ranges. It is predicted that ungulates will become aware of the development's presence, and after a period of adjustment restrict their movements accordingly. The reduction of feeding grounds is not considered significant.

With more residents on the Reserve, potential exists for indiscriminate killing of ungulates. Therefore, hunting is to be strictly regulated by the Band Council and the regulations clearly explained to present and future residents.

The presence of the residential area and the sanitary landfill site has potential for impact on bears, scavengers and rodents. The landfill site is to be fenced, and if properly operated, should not present an attraction to bears. The presence of people in the area can lead to feeding and/or molesting of bears with consequent adverse impacts. Again, regulations concerning the feeding of wildlife will have to be strictly enforced. A solid waste collection system is already in operation and individual properties are kept free of garbage which would attract bears or scavengers. To date, no problems have been reported.

5.4.4 Aquatic Resources

With expected changes in water quality being relatively minor, the impacts on aquatic resources are also expected to be minor. No impacts are expected on benthos and periphyton in the Elbow River.

Angling is presently practiced by the Indians on the Reserve and only by special permit by non-natives. However, with an increase in the number of residents, angling will be allowed to the residents in order to further add to the recreational amenities of the development. Although the Elbow River has a relatively high capability for sport fishing, further study should be carried out in order to determine the extent of fishing which should be allowed. Consequently, regulations can be drawn up for residents who wish to fish. These regulations should restrict the season, daily catch limit, species, and size of fish to be caught, so as not to deplete this resource. Locations along the River or it's tributaries which are used for spawning or rearing areas should be marked off-limits for anglers.

5.4.5 Resource Use

Agriculture, forestry, and grazing are uses which will not be affected by the proposed residential development directly. In the long run, the infusion of money by the development will tend to benefit agriculture and grazing *presently practiced in other areas of the Reserve by providing an opportunity for improvements. A potential for archeological findings exists and care should be taken during the construction operation in recording and/or collecting any items of historical value.*

The intrusion of the proposed residential development would tend to reduce the recreational capability of the area locally. However, because of restricted access to the Reserve, the area has never been used to it's full potential for recreation. The development will tend to make the area more accessible to more people and will enhance recreational capability with man-made facilities such as a golf course, arena, etc. Hunting and fishing will be allowed but under strict control. Other activities such as cross-country skiing, snowmobiling, photography, and nature study will be available to the residents.

The development will, if properly managed, have an overall beneficial impact on the recreational capability of the area.

5.4.6 Noise and Hazards

Noise from construction is expected to be of short-term duration and should not adversely affect nearby communities. The development itself is not expected to face noise levels any higher than a normal urban residential development. Because of increased traffic generated by the development, potential exists for increased noise levels on Highway 22. Higher traffic volumes along Highway 22 are also expected from a growth in through traffic between Calgary and Bragg Creek. The potential growth in total traffic along Highway 22 will require a monitoring program to be set up. Therefore, present noise levels should be measured in order to establish background data. As development occurs, noise levels can again be measured and appropriate action for attenuation be taken should unacceptable noise levels be determined. For the moment a buffer strip of trees is left between the development and the Highway.

Flooding, as previously stated, is expected to occur. The recommendations of the Prairie Farm Rehabilitation Administration have been followed in the design of the development in order to minimize adverse effects of flooding. Since the dykes are constructed of native materials, some seepage will occur during a major flood. However, the existence of transverse dykes will reduce the velocity of flood waters travelling through the development. Seepage is expected to be slow enough to allow proper evacuation in case of flood. Drainage paths and culverts through the dykes are located so as to allow drainage when a flood begins to ebb.

Residential and commercial fire protection is being provided as part of the community water system. It is intended to fill several large depressions in the area with water which can be used in controlling larger bush fires which might occur. Standby high-volume gasoline powered pumps should be provided for this purpose.

5.5 MITIGATION AND RESIDUAL IMPACTS

5.5.1 Project Mitigative Measures

Some of the features of the proposed development which would tend to reduce adverse impacts and enhance positive impacts are as follows:

a) Large lots;
b) Selective clearing;
c) Community water system;
d) Sewage collection treatment and disposal system;
e) Solid waste collection and disposal system;
f) Dyking for flood control;
g) Fire protection system;
h) Recreation facilities;
i) Fishing and hunting regulations; and
j) Building regulations.

5.5.2 Residual Impacts

Long-term impacts of the proposed development will be mainly in the social and economic aspects of the environment as the area grows into a more autonomous community.

Minor residual impacts are expected on the biological and physical environment from the following sources:

a) Increased runoff from developed areas;
b) Spray irrigation of treated sewage effluent should benefit grazing activity; and
c) Long-term reduction of ungulates in the immediate area surrounding the residential development.

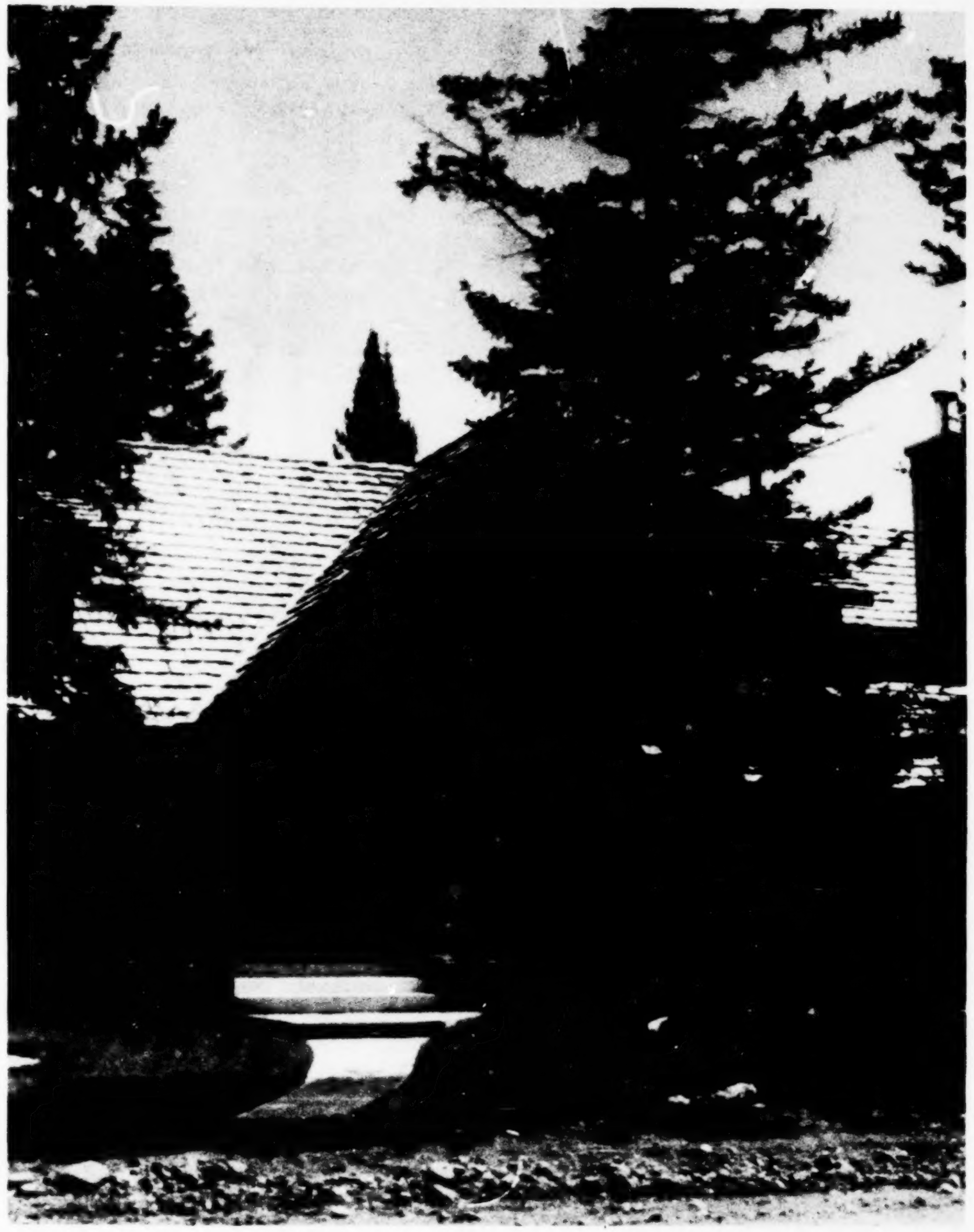
5.6 CONCLUSIONS AND RECOMMENDATIONS

The analysis, within the limited scope as defined, has not identified any major impacts of the proposed development on the environment. Potential exists, however, for adverse impacts in several areas if proper precautions are not taken. These are:

- a) *Water quality may be affected by surface runoff and by improper operation of the lagoon;*
- b) *Fish resource may be affected by water quality and uncontrolled angling;*
- c) *Wildlife may be affected by the presence of humans or improper operation of the landfill site fire; and*
- d) *Flooding may cause serious damage if adequate measures for its control are not provided.*

All of the above items should cause minimal adverse impact if the measures suggested in the plan are followed. In addition, the following studies are recommended:

- a) *A more detailed inventory of the fish resource;*
- b) *Investigation of practical methods for effective control of bush fires;*
- c) *Consideration should be given to the establishment of a permanent fire chief in addition to the volunteer fire department;*
- d) *Further study undertaken to establish limitations on the use of pesticides and herbicides;*
- e) *Continuation of piezometric recordings presently underway until May of 1981 to establish an accurate groundwater profile; and*
- f) *Computation of backwater curves (presently underway) using the proposed dyke alignment.*



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6.0 BIBLIOGRAPHY

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